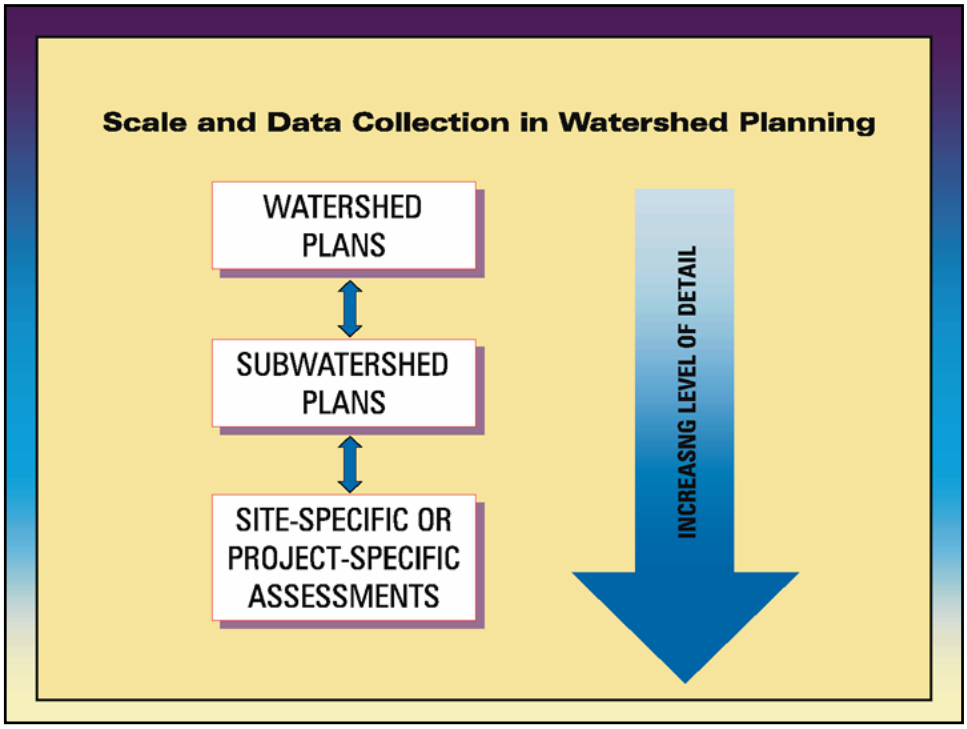
Contents of a Watershed Plan

Barry Tonning
Tetra Tech

What are your "big picture" management objectives?

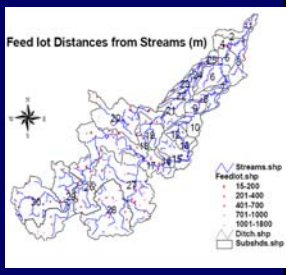
Examples

- Restore aquatic habitat by addressing channel instability and sedimentation
- Protect drinking water reservoir from excessive nutrient loads & eutrophication



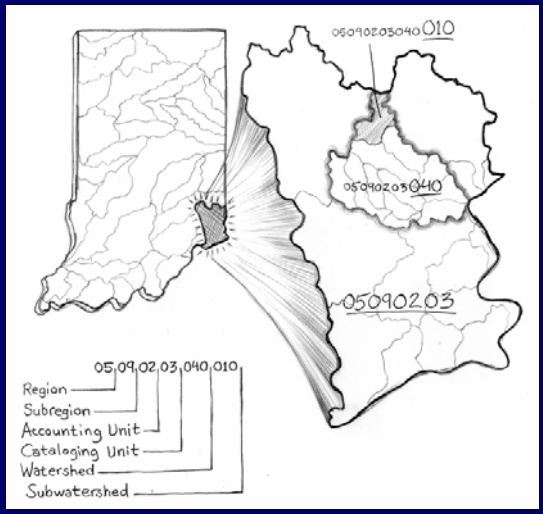
Contents of a Watershed Plan

- Introduction
  - Plan area & description, partners, background
- Water quality information & analysis
  - WQS & goals, monitoring/assessment results
  - Key pollutants / stressors, sources, current loads
- Proposed management measures
  - Load reductions needed, BMP types proposed
  - Reductions expected from BMPs, installation sites
- Implementation plan
  - Public info/education & outreach/involvement plan
  - BMP/$$/TA support sources, project schedule & costs
- Monitoring and adaptive management approach
  - Interim measurable milestones, load reduction criteria
  - Evaluation framework, monitoring plan & partners



Introduction

- Geographic area
  - Basis for selection
- Watershed inventory
  - Physical description
  - Climate
  - Geology
  - Hydrology
  - Soils
  - Biota
  - Land cover & uses
  - Resources & recreation
  - Programmatic infrastructure
  - Economic, social, cultural and historic background
- Partners



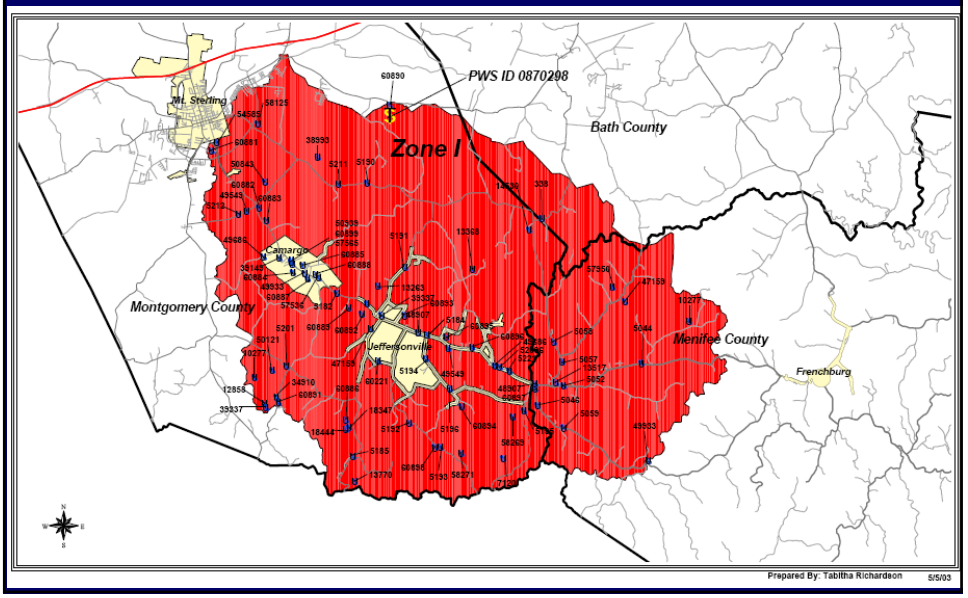
Water quality info & analysis

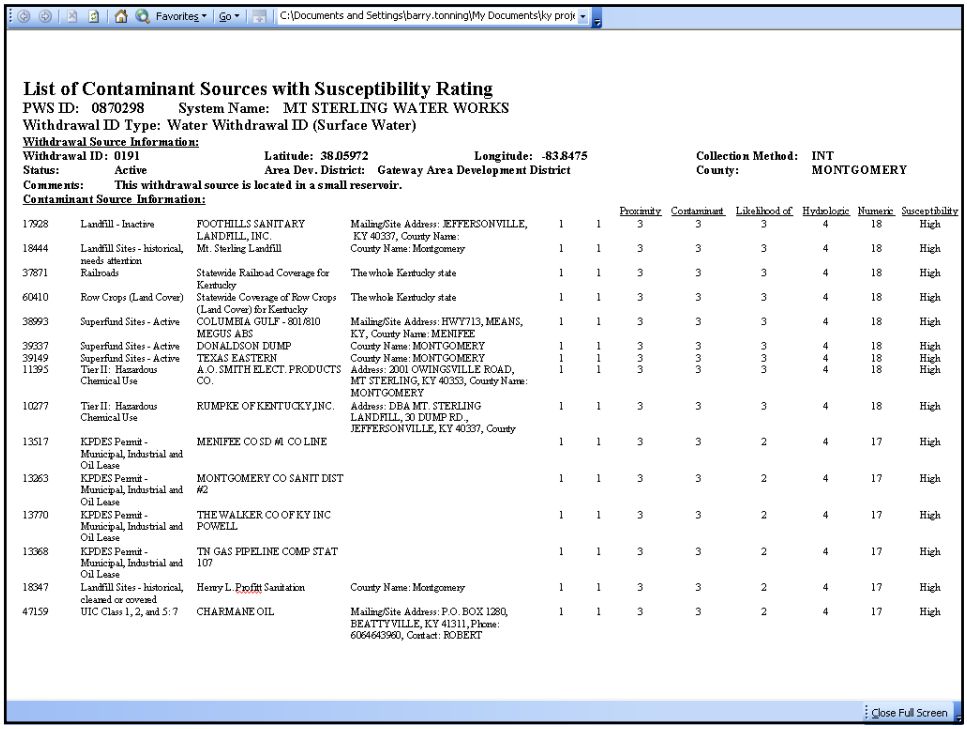
- Water quality goals
  - Designated uses, WQ criteria
  - Restoration and protection goals
  - Flooding, aesthetics, others???
- Monitoring and assessment results
  - Desktop data mining, local monitoring results
  - ID impaired & threatened waters
  - CWA 106 program data & 305b reports
- Key pollutants / stressors
  - Check 303(d); local monitoring/assessment
- Pollutant sources
  - From 303(d) or other assessment
- Current pollutant estimates
  - Estimate, model, or otherwise describe

Types of Data for Watershed Characterization

- **Physical and Natural Features**
  - Watershed boundaries
  - Hydrology
  - Topography
  - Soils
  - Climate
  - Habitat
  - Wildlife
- **Land Use and Population Characteristics**
  - Land use and land cover
  - Existing management practices
  - Demographics
- **Waterbody Conditions**
  - Water quality standards
  - 305(b) report
  - 303(d) list
  - TMDL reports
  - Source Water Protection Areas
- **Pollutant Sources**
  - Point sources
  - Nonpoint sources
- **Waterbody Monitoring Data**
  - Water quality data
  - Flow data
  - Biological data

Source Water Protection Map





List of Contaminant Sources with Susceptibility Rating

PWS ID: 0870298 System Name: MT STERLING WATER WORKS
Withdrawal ID Type: Water Withdrawal ID (Surface Water)
Withdrawal Source Information:
Withdrawal ID: 0191 Latitude: 38.05972 Longitude: -83.8475 Collection Method: INT
Status: Active Area Dev. District: Gateway Area Development District County: MONTGOMERY
Comments: This withdrawal source is located in a small reservoir.
Contaminant Source Information:

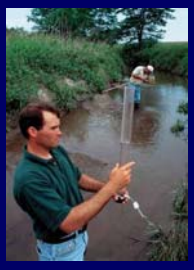
						Proximity	Contaminant	Likelihood of	Hydrologic	Numeric	Susceptibility
17928	Landfill - Inactive	FOOTHILLS SANITARY LANDFILL, INC.	Mailing/Site Address: JEFFERSONVILLE, KY 40337, County Name:	1	1	3	3	3	4	18	High
18444	Landfill Sites - historical, needs attention	Mt. Sterling Landfill	County Name: Montgomery	1	1	3	3	3	4	18	High
37871	Railroads	Statewide Railroad Coverage for Kentucky	The whole Kentucky state	1	1	3	3	3	4	18	High
60410	Row Crops (Land Cover)	Statewide Coverage of Row Crops (Land Cover) for Kentucky	The whole Kentucky state	1	1	3	3	3	4	18	High
38993	Superfund Sites - Active	COLUMBIA GULF - 801/810 MEGUS ABS	Mailing/Site Address: HWY713, MEANS, KY, County Name: MENIFEE	1	1	3	3	3	4	18	High
39337	Superfund Sites - Active	DONALDSON DUMP	County Name: MONTGOMERY	1	1	3	3	3	4	18	High
39149	Superfund Sites - Active	TEXAS EASTERN	County Name: MONTGOMERY	1	1	3	3	3	4	18	High
11395	Tier II: Hazardous Chemical Use	A.O. SMITH ELECT. PRODUCTS CO.	Address: 2001 OWINGSVILLE ROAD, MT STERLING, KY 40353, County Name: MONTGOMERY	1	1	3	3	3	4	18	High
10277	Tier II: Hazardous Chemical Use	RUMPKE OF KENTUCKY,INC.	Address: DBA MT. STERLING LANDFILL, 30 DUMP RD., JEFFERSONVILLE, KY 40337, County	1	1	3	3	3	4	18	High
13517	KPDES Permit - Municipal, Industrial and Oil Lease	MENIFEE CO SD #1 CO LINE		1	1	3	3	2	4	17	High
13263	KPDES Permit - Municipal, Industrial and Oil Lease	MONTGOMERY CO SANIT DIST #2		1	1	3	3	2	4	17	High
13770	KPDES Permit - Municipal, Industrial and Oil Lease	THE WALKER CO OF KY INC POWELL		1	1	3	3	2	4	17	High
13368	KPDES Permit - Municipal, Industrial and Oil Lease	TN GAS PIPELINE COMP STAT 107		1	1	3	3	2	4	17	High
18347	Landfill Sites - historical, cleaned or covered	Henry L. Proffitt Sanitation	County Name: Montgomery	1	1	3	3	2	4	17	High
47159	UIC Class 1, 2, and 5: 7	CHARMANE OIL	Mailing/Site Address: P.O. BOX 1280, BEATTYVILLE, KY 41311, Phone: 6064643960, Contact: ROBERT	1	1	3	3	2	4	17	High

Close Full Screen

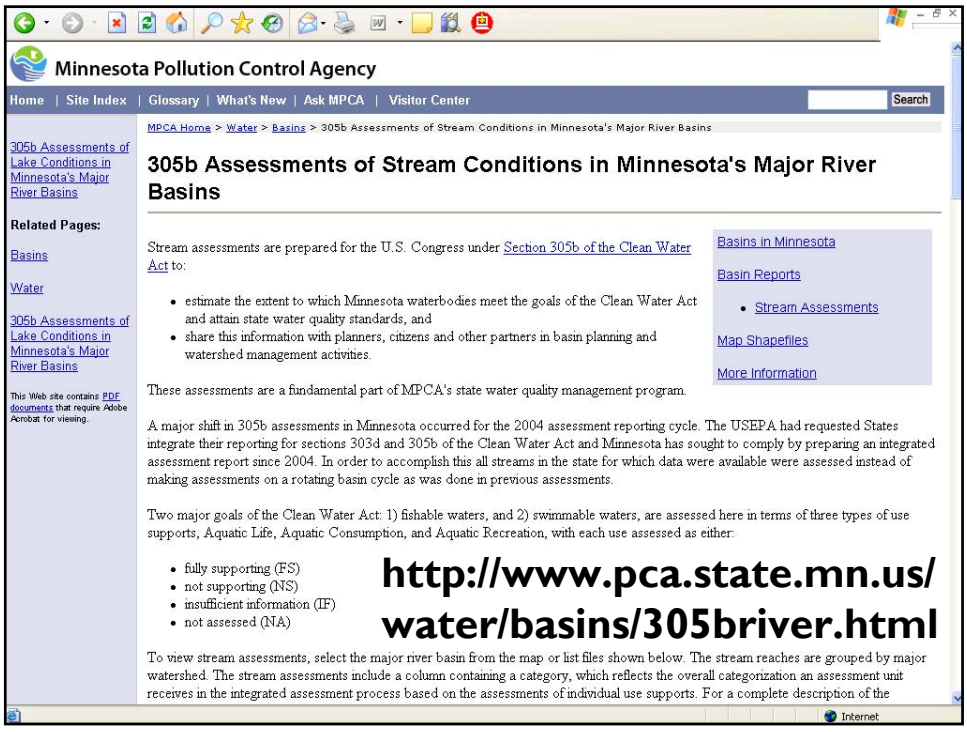
Sample Data Sources

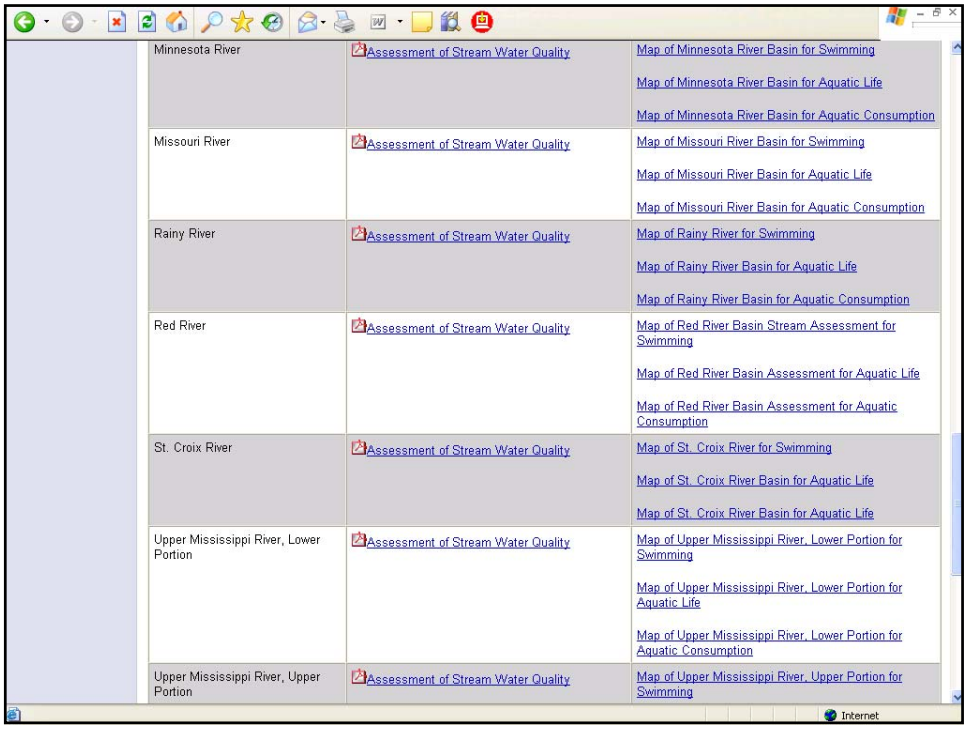
- Watershed Coverages:
  - 8 digit: http://water.usgs.gov/GIS/huc.html
  - 14 digit: www.ncgc.nrcs.usda.gov/products/datasets/watershed
  - EPA Reach Files - 3 versions RF1, RF2, RF3 Alpha (most detailed)
  - www.epa.gov/waterscience/ftp/basins/gis_data/huc/
- Elevation Data
  - USGS: http://edc.usgs.gov/geodata
  - GIS data depot: http://data.geocomm.com
- Land Use/Population
  - USGS: http://edc.usgs.gov/geodata
  - EPA: www.epa.gov/nrlc/nlcd.html
- BLM Management Plans
  - www.blm.gov/planning/plans.html

Other Data Sources



- State 303 (d) lists and TMDL reports
  - www.epa.gov/owow/tmdl
- Point source discharge permits
  - www.epa.gov/enviro/html/pcs/index.html
- Agricultural Statistics
  - http://www.nass.usda.gov/index.asp
- Septic tank use
  - http://quickfacts.census.gov/





Minnesota River	Assessment of Stream Water Quality	Map of Minnesota River Basin for Swimming Map of Minnesota River Basin for Aquatic Life Map of Minnesota River Basin for Aquatic Consumption
Missouri River	Assessment of Stream Water Quality	Map of Missouri River Basin for Swimming Map of Missouri River Basin for Aquatic Life Map of Missouri River Basin for Aquatic Consumption
Rainy River	Assessment of Stream Water Quality	Map of Rainy River for Swimming Map of Rainy River Basin for Aquatic Life Map of Rainy River Basin for Aquatic Consumption
Red River	Assessment of Stream Water Quality	Map of Red River Basin Stream Assessment for Swimming Map of Red River Basin Assessment for Aquatic Life Map of Red River Basin Assessment for Aquatic Consumption
St. Croix River	Assessment of Stream Water Quality	Map of St. Croix River for Swimming Map of St. Croix River Basin for Aquatic Life Map of St. Croix River Basin for Aquatic Life
Upper Mississippi River, Lower Portion	Assessment of Stream Water Quality	Map of Upper Mississippi River, Lower Portion for Swimming Map of Upper Mississippi River, Lower Portion for Aquatic Life Map of Upper Mississippi River, Lower Portion for Aquatic Consumption
Upper Mississippi River, Upper Portion	Assessment of Stream Water Quality	Map of Upper Mississippi River, Upper Portion for Swimming

1. An identification of the causes and sources or groups of similar sources that will need to be controlled to achieve the goal identified in element 3 below.

Sources that need to be controlled should be identified at the significant subcategory level with estimates of the extent to which they are present in the watershed (e.g., X number of dairy cattle feedlots needing upgrading, including a rough estimate of the number of cattle per facility; Y acres of row crops needing improved nutrient management or sediment control; or Z linear miles of eroded streambank needing remediation).

Identifying causes and sources

- Identify water quality goals and existing impairments or threats
  - Examples: metals / acidity from X number of abandoned mine lands, sediment & high flows from urban runoff, sediment from construction sites, habitat loss from channelization, etc.
- Estimate pollutant sources requiring controls
  - Examples: # of miles of pasture streams needing fencing; number of mine sites needing treatment with estimates and general profiles of flows, etc.
  - Can "bundle" stressors and/or sources
    - All pasture cattle operations, all development sites
    - All sources of sediment, all sources of phosphorus
- Prioritize & map pollutants and their sources

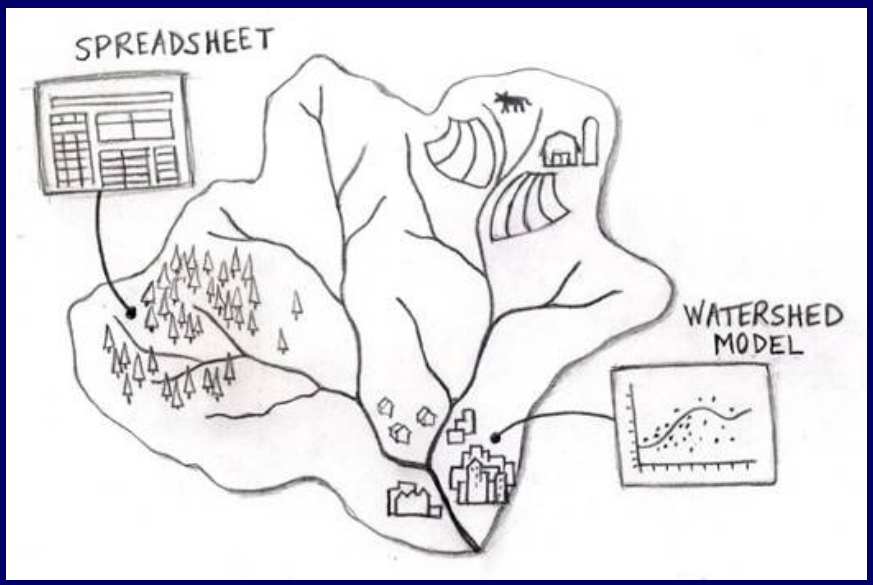
Causes of pollution

Cause/Stressor Category	Impacted Miles
Siltation	1,753.2
Pathogens	1,348.1
Other Habitat Alterations	1,023.1
PCBs	805.5
Organic Enrichment/Low DO	570.2
Nutrients	540.1
Salinity/TDS/Chlorides	499.9
Causes Unknown	463.9
Metals	362.5
Flow Alteration	337.8
Sulfates	240.7
pH	229.7
Dioxins	194.4
Turbidity	141.0
Algal Growth/Chlorophyll *a*	55.1
Suspended Solids	52.8
Unionized Ammonia	39.5
Thermal Modifications	33.1
Unknown Toxicity	19.3
Priority Organics	18.0
Noxious Aquatic Weeds	13.8
Radiation	13.0
Chlorine	12.2
Oil and Grease	11.5
Other Inorganics	11.5
Exotic Species	8.4
Pesticides	5.3
Nonpriority Organics	5.2
Taste and Odor	1.9

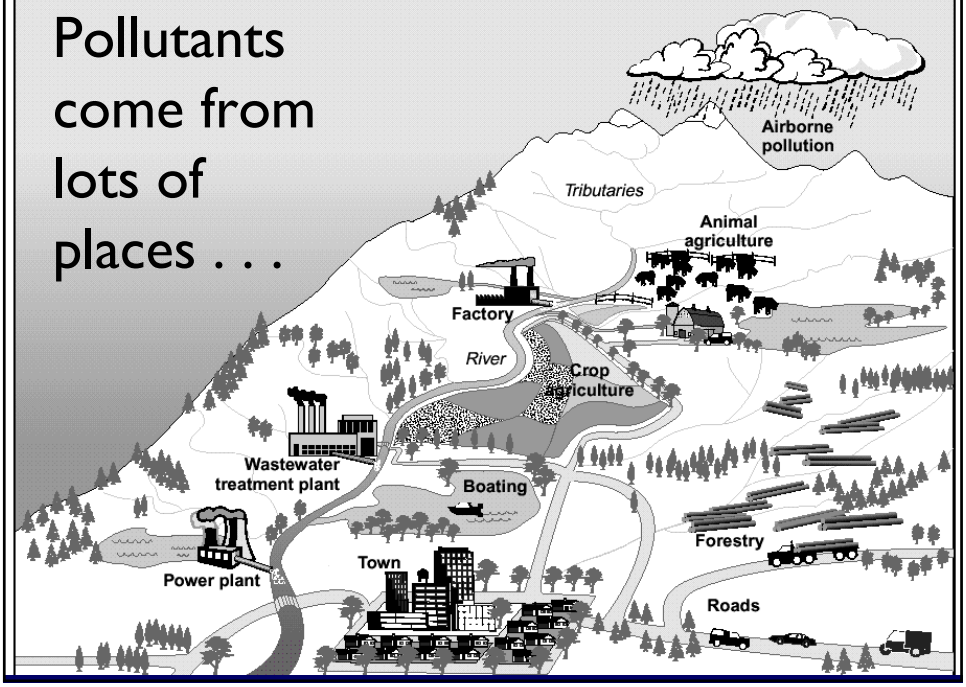
Sources

Source Category	Miles Impacted
Source Unknown	1,631
Agriculture	1,477.2
Crop-related Sources	634.1
Nonirrigated Crop Production	424.4
Irrigated Crop Production	84.4
Specialty Crop Production	3.6
Grazing related Sources	620.8
Pasture grazing - Riparian and/or Upland	222.9
Pasture grazing – Upland	19.6
Range grazing - Riparian and/or Upland	0.7
Intensive Animal Feeding Operations	105.6
Concentrated Animal Feeding Operations (permitted, point source)	22.3
Confined Animal Feeding Operations (NPS)	49.4
Habitat Modification (other than Hydromodification)	1059.2
Removal of Riparian Vegetation	717.7
Bank or Shoreline Modification/Destabilization	265.6
Drainage/Filling of Wetlands	10.7
Resource Extraction	924.7
Surface Mining	525.4
Subsurface Mining	222.8
Dredge Mining	25.6
Petroleum Activities	190.6
Mine Tailings	6.9
Acid Mine Drainage	114.5
Abandoned Mining	91
Inactive Mining	104.1
Urban Runoff/Storm Sewers	721.3
Erosion and Sedimentation	267.3
Non-industrial Permitted	4.3
Industrial Permitted	15.8
Other Urban Runoff	178.3
Illicit Connections/Illegal Hook-ups/Dry Weather Flows	10.6
Hydromodification	527.1
Channelization	403.2
Dredging	92.4
Dam Construction	3.2
Upstream Impoundment	35.1
Flow Regulation/Modification	32.1
Silviculture	254.4
Harvesting, Restoration, Residue Management	156.8
Logging Road Construction/Maintenance	10.5
Silvicultural Point Sources	3.5

How can we identify pollutant sources?



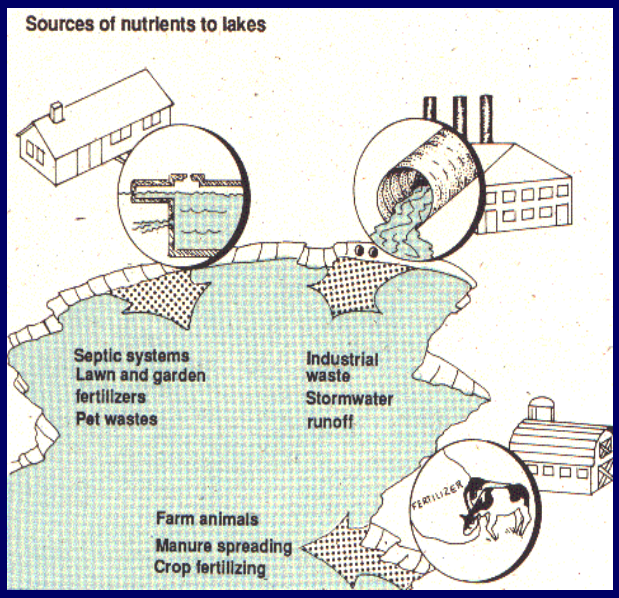
Pollutants come from lots of places . . .



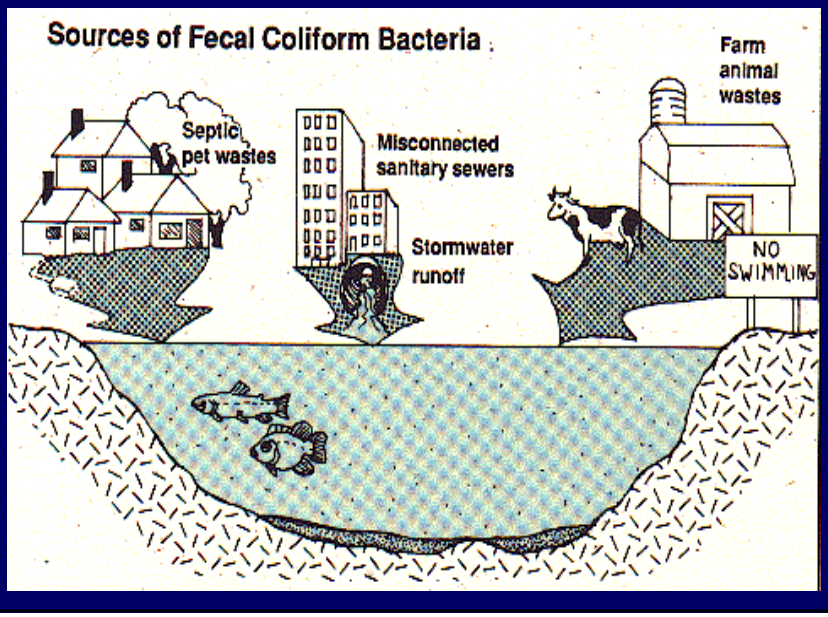
Pollutants come from:

- Point-source discharges (NPDES facilities)
  - Info is available on the discharges (DMRs, etc.)
  - Some are steady-flow, others are precip-driven
- Nonpoint sources (polluted runoff)
  - All are (mostly) precip-driven
  - Identifying & prioritizing sources is tough
  - Literature values can be used to estimate
  - Modeling gets you closer . . . . do you need it?
- Air / atmospheric deposition
  - Can be significant in some locations

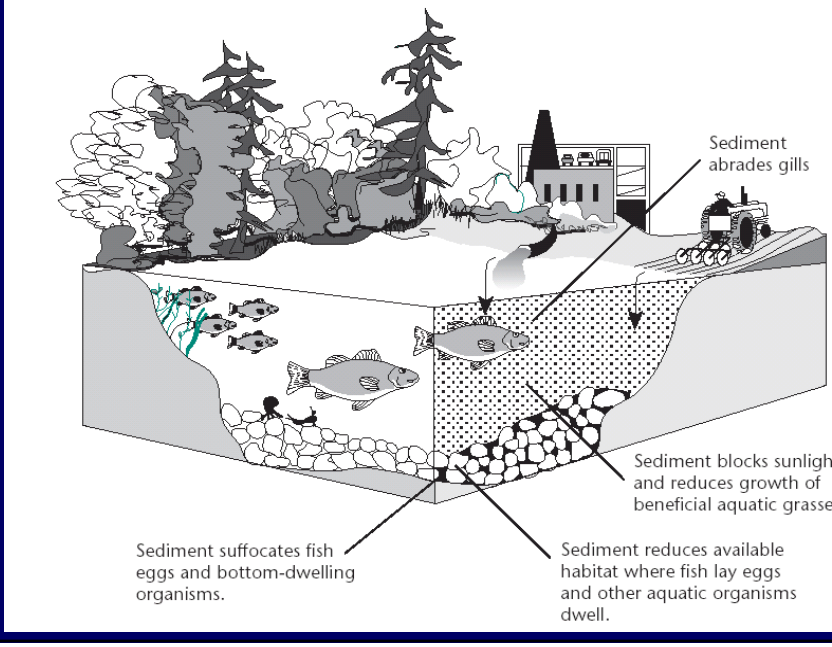
Common NPS pollutants: nutrients

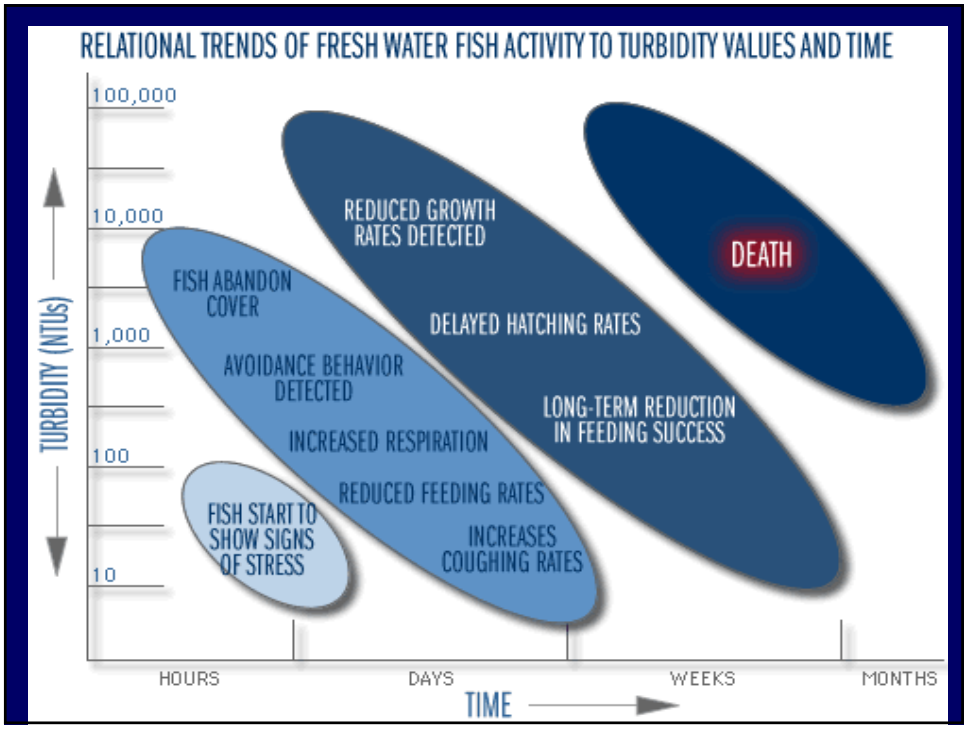


Common NPS pollutants: bacteria



Common NPS pollutants: sediment





Other measures: dissolved oxygen

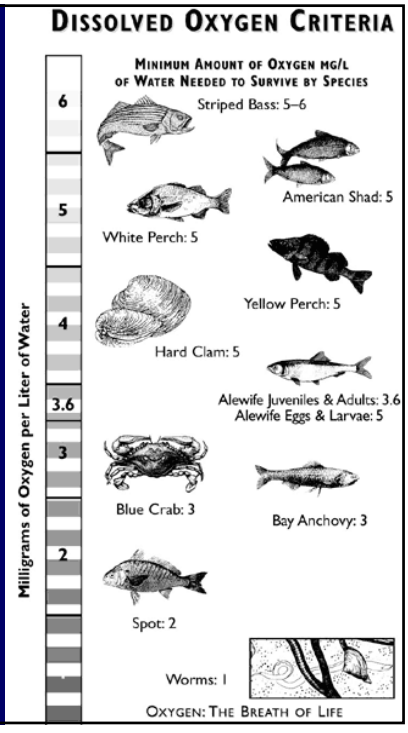


Table 2-2. Summary of Common Pollutants and Sources

Pollutant	Potential Sources		Impacts on Waterbody Uses
	Point Sources	Nonpoint Sources	
Pathogens	• WWTPs • CSOs/SSOs • Permitted CAFOs • Discharges from meat processing facilities • Landfills	• Animals (domestic, wildlife, livestock) • Malfunctioning septic systems • Pastures • Boat pumpout facilities • Land application of manure • Land application of wastewater	• Primarily human health risks • Risk of illness from ingestion or from contact with contaminated water through recreation • Increased cost of treatment of drinking water supplies • Shellfish bed closures
Metals	• Urban runoff • WWTPs • CSO/SSOs • Landfills • Industrial facilities • Mine discharges	• Abandoned mine drainage • Hazardous waste sites (unknown or partially treated sources) • Marinas	• Aquatic life impairments (e.g., reduced fish populations due to acute/chronic concentrations or contaminated sediment) • Drinking water supplies (elevated concentrations in source water) • Fish contamination (e.g., mercury)
Nutrients	• WWTPs • CSOs/SSOs • CAFOs • Discharge from food- processing facilities • Landfills	• Cropland (fertilizer application) • Landscaped spaces in developed areas (e.g., lawns, golf courses) • Animals (domestic, wildlife, livestock) • Malfunctioning septic systems • Pastures • Boat pumpout • Land application of manure or wastewater	• Aquatic life impairments (e.g., effects from excess plant growth, low DO) • Direct drinking water supply impacts (e.g., dangers to human health from high levels of nitrates) • Indirect drinking water supply impacts (e.g., effects from excess plant growth clogging drinking water facility filters) • Recreational impacts (indirect impacts from excess plant growth on fisheries, boat/swimming access, appearance, and odors) • Human health impacts
Sediment	• WWTPs • Urban stormwater systems	• Agriculture (cropland and pastureland erosion) • Silviculture and timber harvesting • Rangeland erosion • Excessive streambank erosion • Construction • Roads • Urban runoff • Landslides • Abandoned mine drainage • Stream channel modification	• Fills pools used for refuge and rearing • Fills interstitial spaces between gravel (reduces spawning habitat by trapping emerging fish and reducing oxygen exchange) • When suspended, prevents fish from seeing food and can clog gills; high levels of suspended sediment can cause fish to avoid the stream • Taste/odor problems in drinking water • Impairs swimming/boating because of physical alteration of the channel • Indirect impacts on recreational fishing
Temperature	• WWTPs • Cooling water discharges (power plants and other industrial sources) • Urban stormwater systems	• Lack of riparian shading • Shallow or wide channels (due to hydrologic modification) • Hydroelectric dams • Urban runoff (warmer runoff from impervious surfaces) • Sediment (cloudy water absorbs more heat than clear water) • Abandoned mine drainage	• Causes lethal effects when temperature exceeds tolerance limit • Increases metabolism (results in higher oxygen demand for aquatic organisms) • Increases food requirements • Decreases growth rates and DO • Influences timing of migration • Increases sensitivity to disease • Increases rates of photosynthesis (increases algal growth, depletes oxygen through plant decomposition) • Causes excess plant growth

Note: WWTP = wastewater treatment plant; CSO = combined sewer overflow; SSO = sanitary sewer overflow; CAFO = concentrated animal feeding operation; DO = dissolved oxygen.


Steady-flow: sewage treatment plant discharge via infrared photography
FEB16/02,0151:29.821,-05,9/01,02160F
0111,3509.153N,08051.294W, 59KTS,205


Nonpoint source: precip-driven
(this may be a point source in some cases!)

Table 9. Unit loads of pollutants (kg/ha/yr) from different land uses*

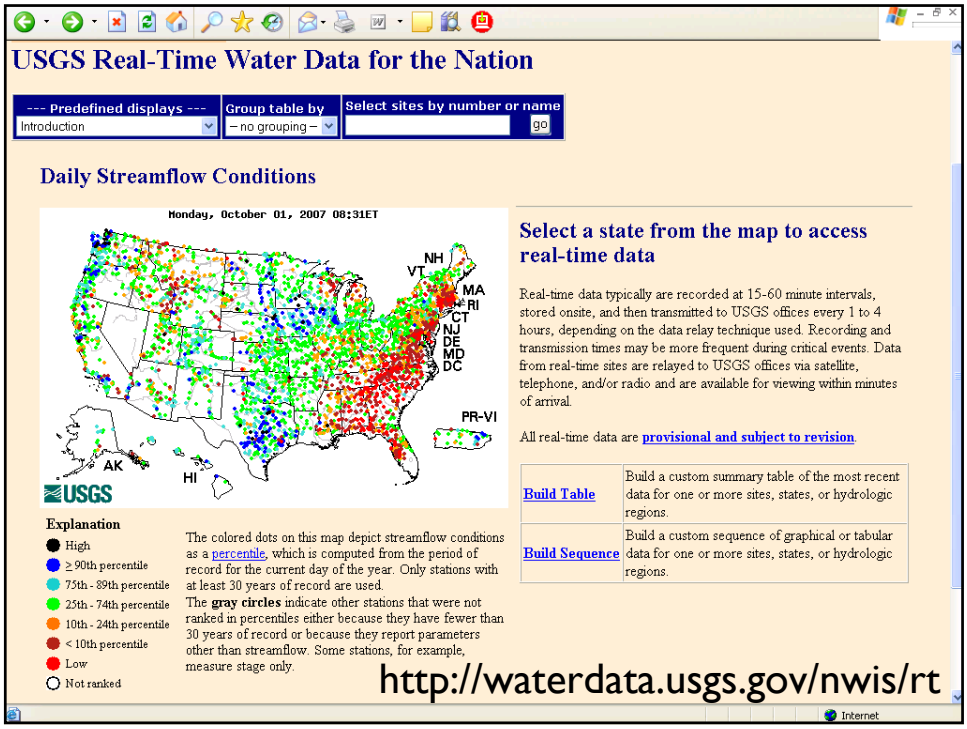
Pollutant	Central business district	Other commercial	Industrial	Single family res.	Multi-family res.	Cropland	Pasture	Forest	Open
TSS	1080	840	56	17	440	450	340	85	7
COD	1070	1020	63	28	330	n.a.	n.a.	n.a.	2.0
Pb	7.1	3.0	2.0 - 7.1	0.1	0.7	0.005 - 0.006	0.003 - 0.015	0.01 - 0.03	n.a.
Zn	3.0	3.3	3.5 - 12	0.22	0.33	0.03 - 0.08	0.02 - 0.17	0.01 - 0.03	n.a.
Cu	2.1	n.a.	0.33 - 1.1	0.03	0.33	0.01 - 0.06	0.02 - 0.04	0.02 - 0.03	n.a.
NO_3+$N0_2$-N	4.5	0.67	0.45	0.33	3.8	7.9	0.33	0.56	0.33
TKN	15	15	2.2 - 15	1.1 - 5.6	3.4 - 4.5	1.7	0.67	2.9	1.7
TP	2.8	2.7	0.9 - 4.0	0.2 - 1.5	1.3 - 1.6	0.1 - 3.0	0.07 - 3.0	0.02 - 0.45	0.06

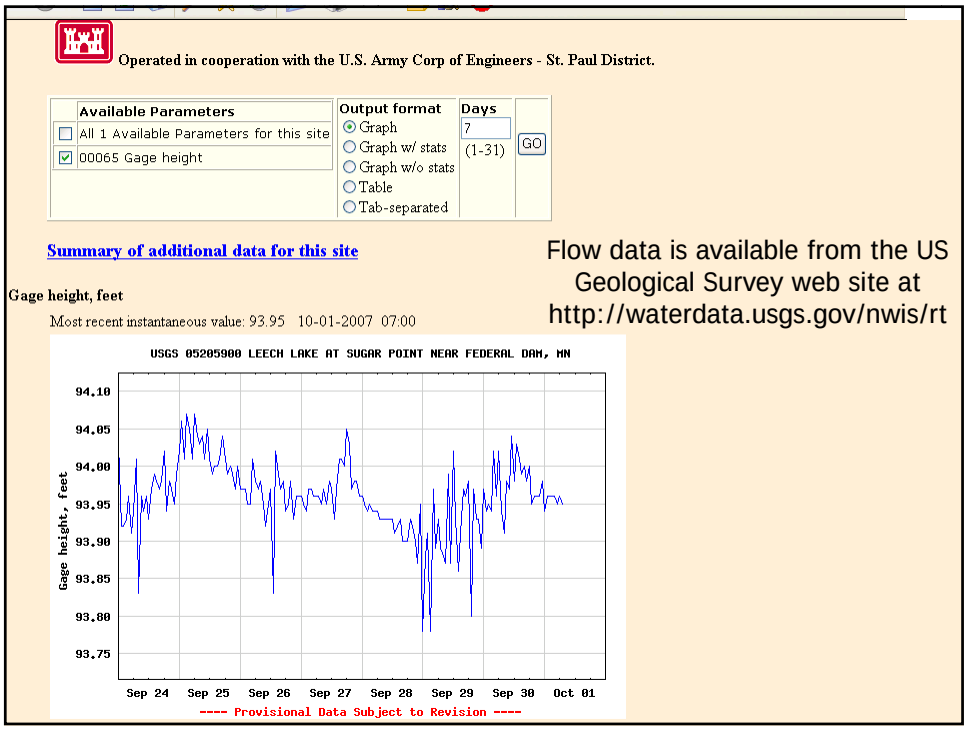
* Exact values are given where available; otherwise ranges are reported.

Adapted from Horner et al. (1986)

Identification of causes & sources

- What "pollutants" are you dealing with?
  - Chemical or other stressors or causes of impairment
- How big is the problem for each?
- How do you know?
  - Did you measure or prioritize them?
  - Did you estimate? How?
- Where are they coming from?
  - Can you put the info on a map?
- Can you estimate the % from each source?

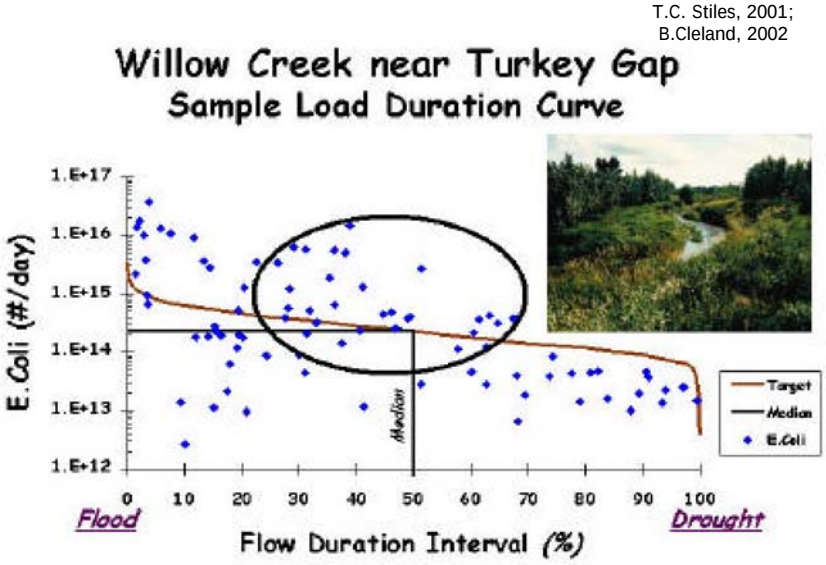




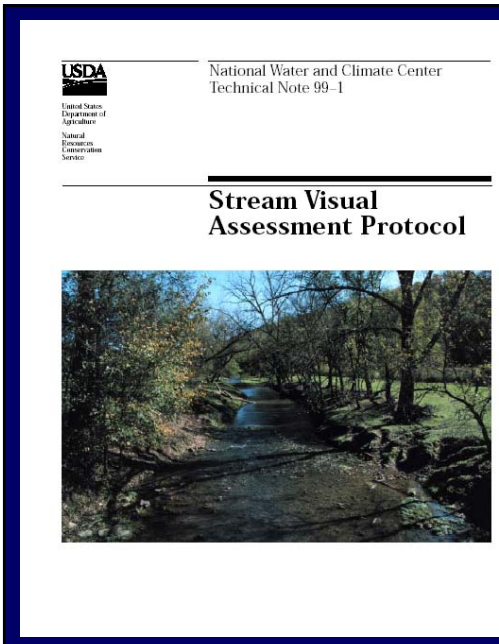
Flow data is available from the US Geological Survey web site at http://waterdata.usgs.gov/nwis/rt

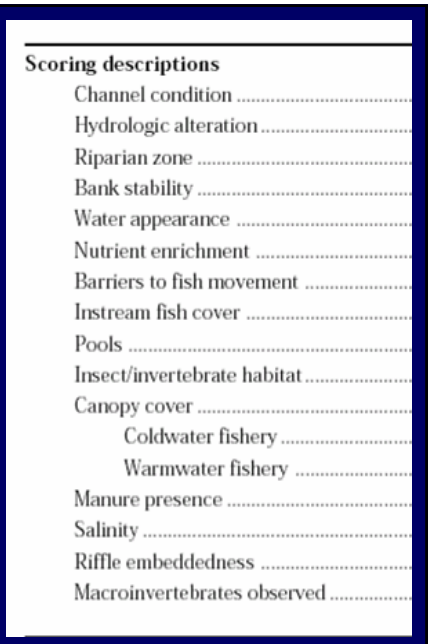
Figure 2. Duration Curve with Contributing Area Focus

T.C. Stiles, 2001;
B.Cleland, 2002

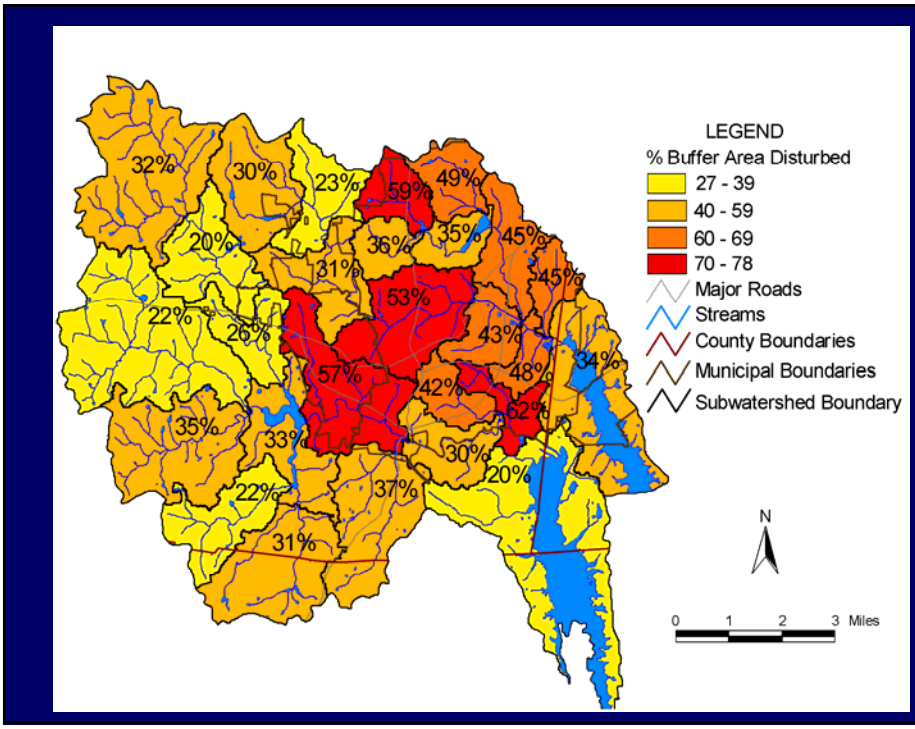


TARGETED Programs: *Riparian Buffers (e.g. CRP, CREP)*





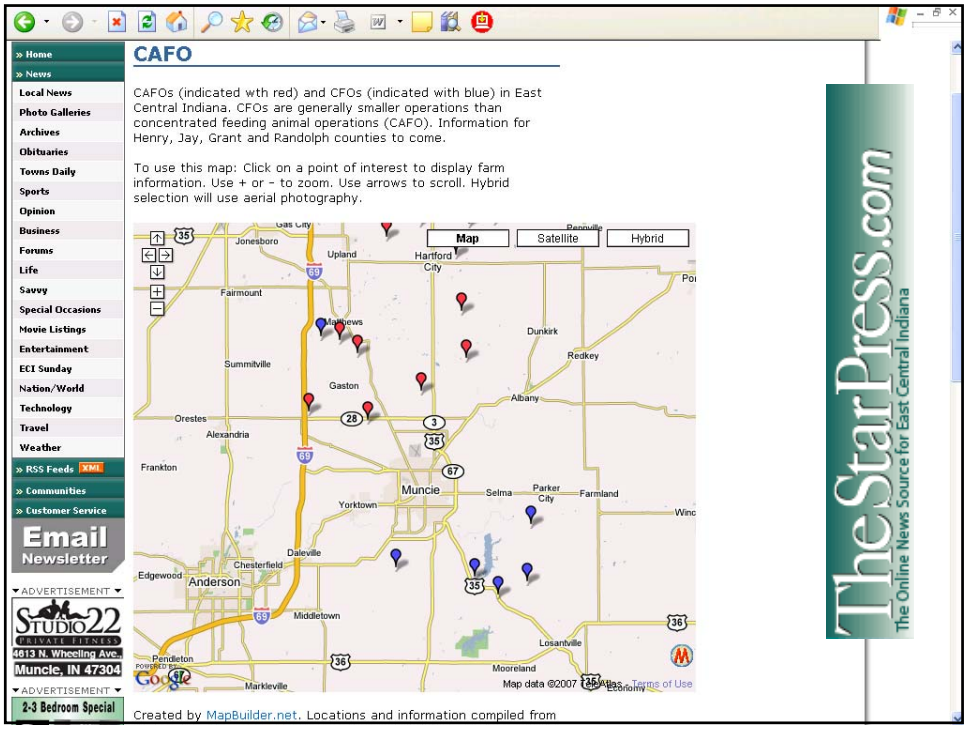
http://www.nrcs.usda.gov/technical/ECS/aquatic/svapfnl.pdf



Supplementing available data

- Windshield surveys
- Interviews with residents
- Volunteer monitoring
- Bioassessment
- Targeted sampling
- Chemical/biological sampling

Helps lay the groundwork for implementation!



2. A description of the NPS management measures

that will need to be implemented to achieve a water quality-based goal described in element 3 below, as well as to achieve other watershed goals identified in the watershed-based plan, and an identification (using a map or a description) of the critical areas for which those measures will be needed to implement the plan.

Identifying the NPS management measures needed

- Management measures or BMPs should be linked to (or otherwise address) stressors and sources
  - Water quality goals or estimates for pollutant removal rates should be included
  - Can be based on typical ranges, i.e., percentage removed/treated, reasonable estimates, etc.
- Specify or map areas where BMPs will be used or installed
  - Examples: all abandoned mine sites with dry weather flows; all streambanks along upper reaches; livestock facilities on Willow Run; etc.

Option: estimate the load reductions expected or needed

- Tribes can set general/narrative water quality goals or adopt load reduction strategies
- Calculate the total pollutant load reductions or other benefits expected from the management measures
  - Examples: avg. tons of sediment reduction per day; acres of rangeland under management plans; miles of eroded streambank repaired; lbs of metals trapped per cu ft of waste pile treated; etc.
- If achieving WQ criteria is the goal, estimate initial loadings, calculate reductions needed, and compare to expected reductions
  - Approach can be phased in over time
  - The key success criterion is progress toward goals

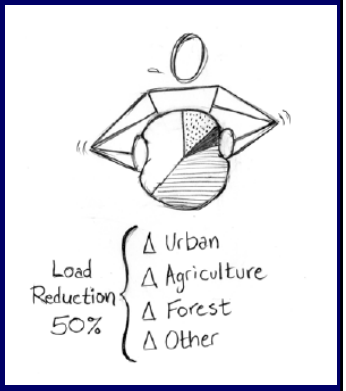
Select the best options

Describe NPS management measures needed to achieve pollutant reductions

- What is essential to achieving objectives?
- Which options are preferred by stakeholders?
- Which options have greatest chance for long term success and sustainability?

Proposed management measures

- Pollutant reductions needed
  - Estimate reductions desired
  - Approach selected should make sense!
- BMP types proposed
  - What will reduce pollutants?
  - Applicable to your situation?
- BMP water quality benefits
  - Can you estimate BMP impacts?
  - Use literature or actual values
- BMP installation sites
  - Which sites will hit the source(s)?
  - Are there critical areas to focus on?



Prioritizing/targeting BMPs

- Importance of waterbody
  - Drinking water source, recreational resource
- Magnitude of impairment(s)
  - Level of effort needed; public interest/attention
- Existing loads (stressors & sources)
  - Magnitude, spatial variation, clustering
- Ability of BMPs to reduce loads
  - Sure thing, or a shot in the dark?
- Feasibility of implementation
  - Willing partners? Public support?
- Additional benefits
  - Recreational enhancements, demonstration

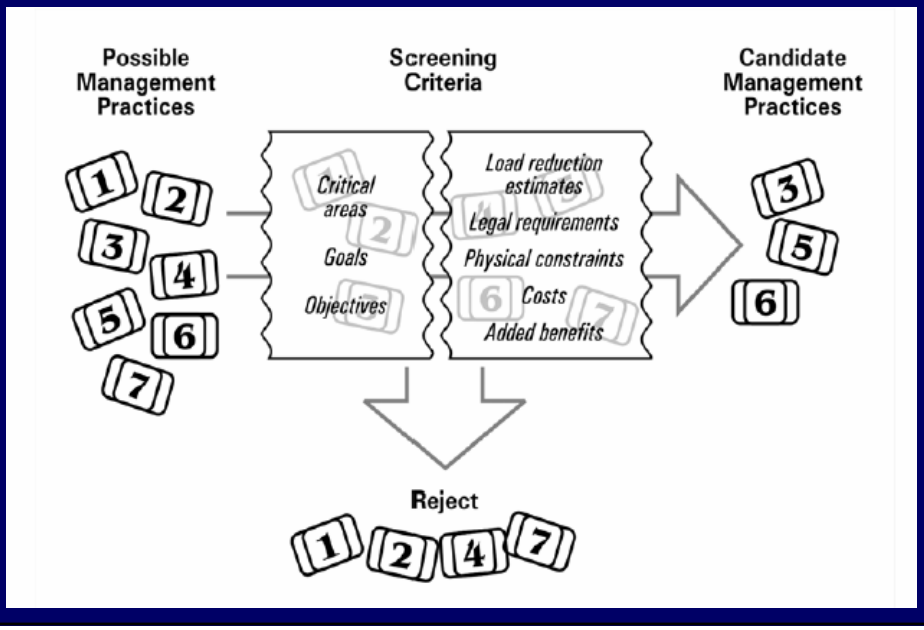
Select the most appropriate BMPs

- Look at what's worked and what hasn't
- Research effectiveness
- Consider costs/benefits
- Property ownership/site access
- Look for added benefits
- Use a combination of techniques
- Focus efforts on critical areas; use more or better BMPs there

Examples of Different Scenarios to Meet the Same Target

Source	Existing Phosphorus Loading (kg/y)	Scenario 1		Scenario 2	
		% Load Reduction	Allowable Load (kg/y)	% Load Reduction	Allowable Load (kg/y)
Roads	78	26	58	20	62
Pasture/Hay	21	26	16	10	19
Cropland	218	26	162	55	98
Forest	97	26	72	0	97
Landfill	7	26	5	0	7
Residential	6	26	5	0	6
Groundwater	111	26	83	0	111
Total	539	26	400	26	400

Identify candidate practices



Reducing pollutants: the basics

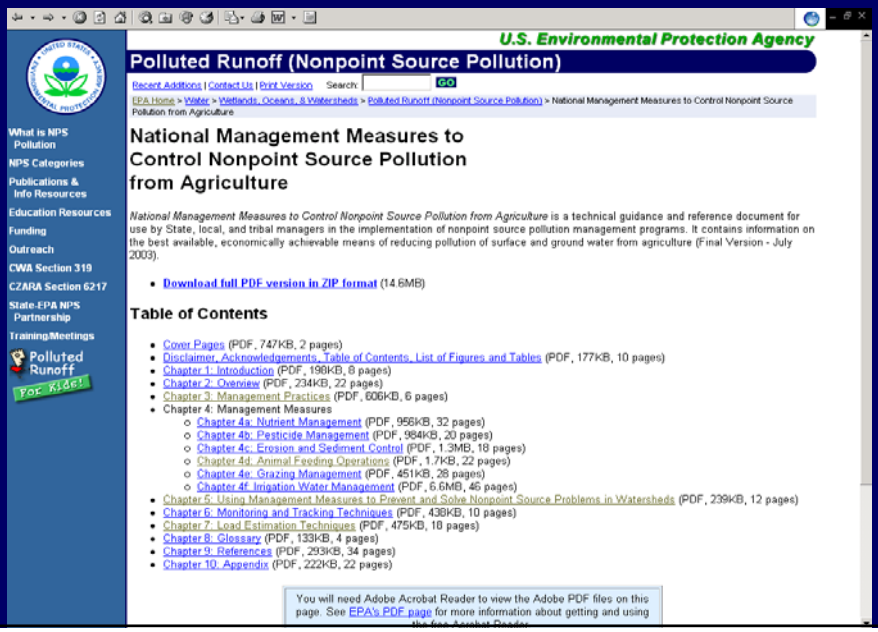
- Simple (linear) approach
  - Use observed data
  - Empirical relationships
  - Reduce the concentration
  - Reduce the source area
  - Reduce # of sources
- Complex (modeled) approach
  - Model the pollutants
  - Model BMP reductions
  - Layers can include topography, soils, climate, land use, land cover, pollutant transport/fate, point sources, management practices, etc.

References for determining BMP effectiveness

- Stormwater/Urban (BMP Effectiveness database; Menu of BMPs)
- Agriculture (Ag Management Measure document)
- Forestry (Forestry Management Measures document)
- Mining (Development document for proposed Effluent Guideline for Mining)

www.epa.gov/nps

www.epa.gov/owow/nps/agmm/index.html



U.S. Environmental Protection Agency

Polluted Runoff (Nonpoint Source Pollution)

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EPA Home > Water > Wetlands, Oceans, & Watersheds > Polluted Runoff (Nonpoint Source Pollution) > National Management Measures to Control Nonpoint Source Pollution from Agriculture

What is NPS Pollution
NPS Categories
Publications & Info Resources
Education Resources
Funding
Outreach
CWA Section 319
CZARA Section 6217
State-EPA NPS Partnership
Training/Meetings
Polluted Runoff For Kids!

National Management Measures to Control Nonpoint Source Pollution from Agriculture

National Management Measures to Control Nonpoint Source Pollution from Agriculture is a technical guidance and reference document for use by State, local, and tribal managers in the implementation of nonpoint source pollution management programs. It contains information on the best available, economically achievable means of reducing pollution of surface and ground water from agriculture (Final Version - July 2003).

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- Disclaimer, Acknowledgements, Table of Contents, List of Figures and Tables (PDF, 177KB, 10 pages)
- Chapter 1: Introduction (PDF, 198KB, 8 pages)
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- Chapter 3: Management Practices (PDF, 606KB, 6 pages)
- Chapter 4: Management Measures
  - Chapter 4a: Nutrient Management (PDF, 956KB, 32 pages)
  - Chapter 4b: Pesticide Management (PDF, 984KB, 20 pages)
  - Chapter 4c: Erosion and Sediment Control (PDF, 1.3MB, 18 pages)
  - Chapter 4d: Animal Feeding Operations (PDF, 1.7KB, 22 pages)
  - Chapter 4e: Grazing Management (PDF, 451KB, 28 pages)
  - Chapter 4f: Irrigation Water Management (PDF, 6.6MB, 46 pages)
- Chapter 5: Using Management Measures to Prevent and Solve Nonpoint Source Problems in Watersheds (PDF, 239KB, 12 pages)
- Chapter 6: Monitoring and Tracking Techniques (PDF, 438KB, 10 pages)
- Chapter 7: Load Estimation Techniques (PDF, 475KB, 18 pages)
- Chapter 8: Glossary (PDF, 133KB, 4 pages)
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- Chapter 10: Appendix (PDF, 222KB, 22 pages)

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www.epa.gov/owow/nps/agmm/ index.html

Table 4d-6. Relative gross effectiveness[a] (load reduction) of animal feeding operation control measures (Pennsylvania State University, 1992b).

Practice[b] Category	Runoff Volume	Total[d] Phosphorus (%)	Total[d] Nitrogen (%)	Sediment (%)	Fecal Coliform (%)
Animal Waste Systems[e]	reduced	90	80	60	85
Diversion Systems[f]	reduced	70	45	NA	NA
Filter Strips[g]	reduced	85	NA	60	55
Terrace System	reduced	85	55	80	NA
Containment Structures[h]	reduced	60	65	70	90

NA = not available.
[a] Actual effectiveness depends on site-specific conditions. Values are not cumulative between practice categories.
[b] Each category includes several specific types of practices.
[d] Total phosphorus includes total and dissolved phosphorus; total nitrogen includes organic-N, ammonia-N, and nitrate-N.
[e] Includes methods for collecting, storing, and disposing of runoff and process-generated wastewater.
[f] Specific practices include diversion of uncontaminated water from confinement facilities.
[g] Includes all practices that reduce contaminant losses using vegetative control measures.
[h] Includes such practices as waste storage ponds, waste storage structures, waste treatment lagoons.

www.bmpdatabase.org/docs.htm

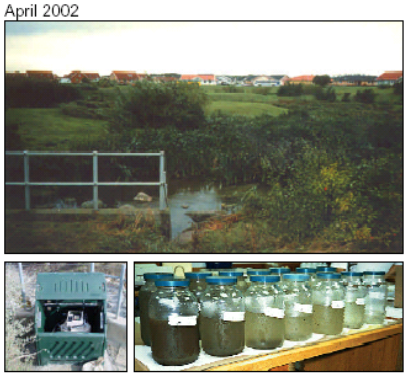
EPA United States Environmental Protection Agency

ASCE American Society of Civil Engineers

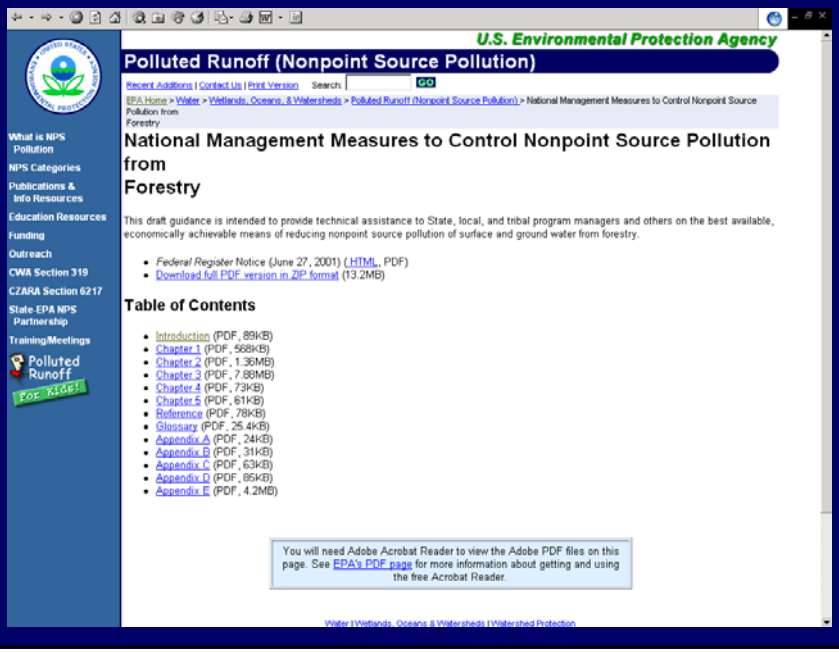
Urban Stormwater BMP Performance Monitoring

A Guidance Manual for Meeting the National Stormwater BMP Database Requirements

April 2002



http://www.epa.gov/owow/nps/forestrymgmt/



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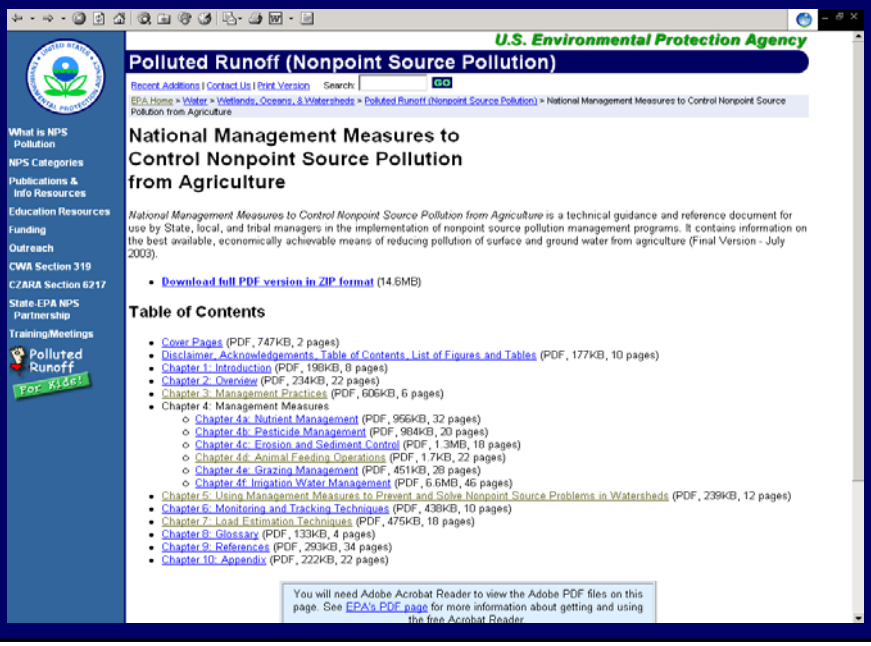


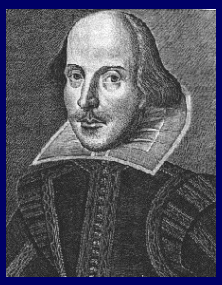
Sample BMP effectiveness table

Table 6-3. BMPs and removal efficiencies used in Site Evaluation Tool BMP percent efficiency

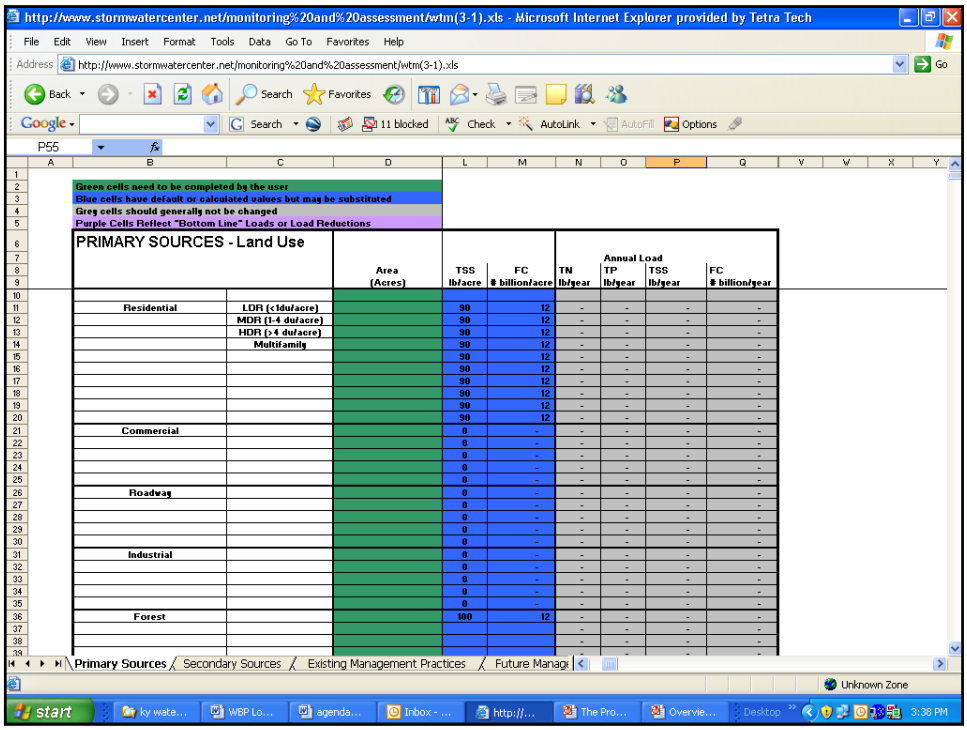
BMP	Percent Efficiency			
	TSS	Total Nitrogen	Total Phosphorus	Fecal Coliform
Wet pond	85 [d]	33 [a]	51 [a]	70 [a]
Dry detention	47 [a]	25 [a]	19 [a]	78 [a]
Stormwater wetland	76 [a]	30 [a]	49 [a]	78 [a]
Sand filter	87 [a]	32 [a]	59 [a]	37 [a]
Bioretention	87 [i,j]	57 [f,g,h]	76 [f,g,h,i]	90 [k]
Enhancedg Grass swale	93 [a]	92 [a]	83 [a]	- 25 [a]
Grass swale	68 [a]	20 [a]	29 [a]	5 [a]
Infiltration trench	95 [a]	51 [a]	70 [a]	90 [e]
25-ft forest buffer	57 [b,c]	27 [b,c]	34 [b,c]	5 [k]
50-ft forest buffer	62 [b,c]	31 [b,c]	38 [b,c]	5 [k]
75-ft forest buffer	65 [b,c]	33 [b,c]	41 [b,c]	5 [k]
100-ft forest buffer	67 [b,c]	34 [b,c]	43 [b,c]	5 [k]
200-ft forest buffer	72 [b,c]	38 [b,c]	47 [b,c]	5 [k]

[a] Winer, R. 2000. National Pollutant Removal Performance Database for Stormwater Treatment Practices, 2nd ed. Center for Watershed Protection, Ellicott City, MD.

To model, or not to model . . .



- As these things increase:
  - Number of pollutants
  - Complexity of loads/stressors
  - Uncertainty regarding existing information
  - Expense involved in addressing problems
- The need for more sophisticated modeling also increases




U.S. Environmental Protection Agency
STEPL - Spreadsheet Tool for Estimating Pollutant Load
Recent Additions | Contact Us | Print Version
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GO
EPA Home > STEPL
Home
Access STEPL Data Server for Input Data
Models and Documentation
Welcome to STEPL
http://it.tetratech-ffx.com/stepl
Spreadsheet Tool for Estimating Pollutant Load (STEPL) employs simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various best management practices (BMPs).STEPL provides a user-friendly Visual Basic (VB) interface to create a customized spreadsheet-based model in Microsoft (MS) Excel. It computes watershed surface runoff, nutrient loads, including nitrogen, phosphorus, and 5-day biological oxygen demand (BOD5); and sediment delivery based on various land uses and management practices. For each watershed, the annual nutrient loading is calculated based on the runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution and management practices. The annual sediment load (sheet and rill erosion only) is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. The sediment and pollutant load reductions that result from the implementation of BMPs are computed using the known BMP efficiencies.
Region 5 model is an Excel workbook that provides a gross estimate of sediment and nutrient load reductions from the implementation of agricultural and urban BMPs. The algorithms for non-urban BMPs are based on the "Pollutants controlled: Calculation and documentation for Section 319 watersheds training manual" (Michigan Department of Environmental Quality, June 1999). The algorithms for urban BMPs are based on the data and calculations developed by Illinois EPA. Region 5 model does not estimate pollutant load reductions for dissolved constituents.
Questions? Please contact:
STEPL E-mail support
Telephone support (EPA and EPA clients only): (703)385-6000 (Ting Dai or Henry Manguerra)
Developed for EPA Office of Water
Grants Reporting and Tracking System
By Tetra Tech, Inc.
Last revised: 7/3/2003
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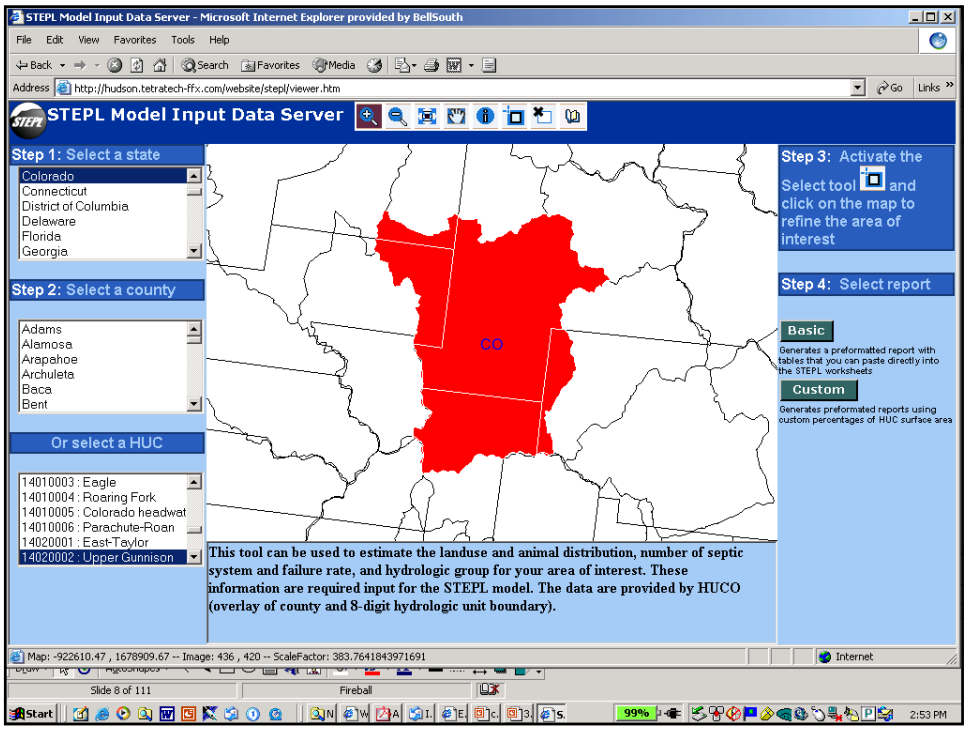

STEPL Model Input Data Server - Microsoft Internet Explorer provided by BellSouth
File Edit View Favorites Tools Help
Address http://hudson.tetratech-ffx.com/website/stepl/viewer.htm
STEPL Model Input Data Server
Step 1: Select a state
Colorado
Connecticut
District of Columbia
Delaware
Florida
Georgia
Step 2: Select a county
Adams
Alamosa
Arapahoe
Archuleta
Baca
Bent
Or select a HUC
14010003 : Eagle
14010004 : Roaring Fork
14010005 : Colorado headwat
14010006 : Parachute-Roan
14020001 : East-Taylor
14020002 : Upper Gunnison
CO
Step 3: Activate the Select tool and click on the map to refine the area of interest
Step 4: Select report
Basic
Generates a preformatted report with tables that you can paste directly into the STEPL worksheets
Custom
Generates preformated reports using custom percentages of HUC surface area
This tool can be used to estimate the landuse and animal distribution, number of septic system and failure rate, and hydrologic group for your area of interest. These information are required input for the STEPL model. The data are provided by HUCO (overlay of county and 8-digit hydrologic unit boundary).
Map: -922610.47 , 1678909.67 -- Image: 436 , 420 -- ScaleFactor: 383.7641843971691
Internet
Slide 8 of 111
Fireball
Start
99%
2:53 PM

3. Septic system data

Polygon ID	No. of Septic Systems	Population per Septic System	Septic Failure Rate,%
9657	487	2.08	0.88
9682	1034	1.41	0.88
9805	571	2.36	0.88
10226	42	2.00	0.88
10249	0	1.52	0.88
10339	0	1.52	0.88
10407	0	1.52	0.88
10439	3	1.52	0.88
10526	332	0.37	0.88
10616	1	1.52	0.88
10697	0	1.52	0.88
10704	0	1.52	0.88
10732	0	1.55	0.88
10765	0	1.55	0.88
10808	0	0.46	0.88
10816	0	0.46	0.88
10819	0	0.46	0.88
10847	0	0.46	0.88
Total	2470	1.63	0.88

Source: National Environmental Service Center: 1992 and 1998 summary of the status of onsite wastewater treatment systems in the United States

4. Hydrological Group

Polygon ID	Hydrological Group
9657	B
9682	B

Unified Subwatershed and Site Reconnaissance Survey

Neighborhood Source Assessment

Hot Spot Investigation

Pervious Area Assessment

Streets and Storm Drain Assessment

Excerpt from Wright et al., 2004

Neighborhood Source Assessment **NSA**

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID:	
DATE: __/__/____	ASSESSED BY:	CAMERA ID:	PIC#:

A. NEIGHBORHOOD CHARACTERIZATION

Neighborhood/Subdivision Name: _____ Neighborhood Area (acres) _____

If unknown, address (or streets) surveyed:

_____

Homeowners Association? ☐ Y ☐ N ☐ Unknown If yes, name and contact information: _____

Residential *(circle average single family lot size):*

☐ Single Family Attached (Duplexes, Row Homes) <⅛ ⅛ ¼ ⅓ ½ acre ☐ Multifamily (Apts, Townhomes, Condos)

☐ Single Family Detached <¼ ¼ ½ 1 >1 acre ☐ Mobile Home Park

Estimated Age of Neighborhood: _____ years | Percent of Homes with Garages: _____% With Basements ____% | INDEX*

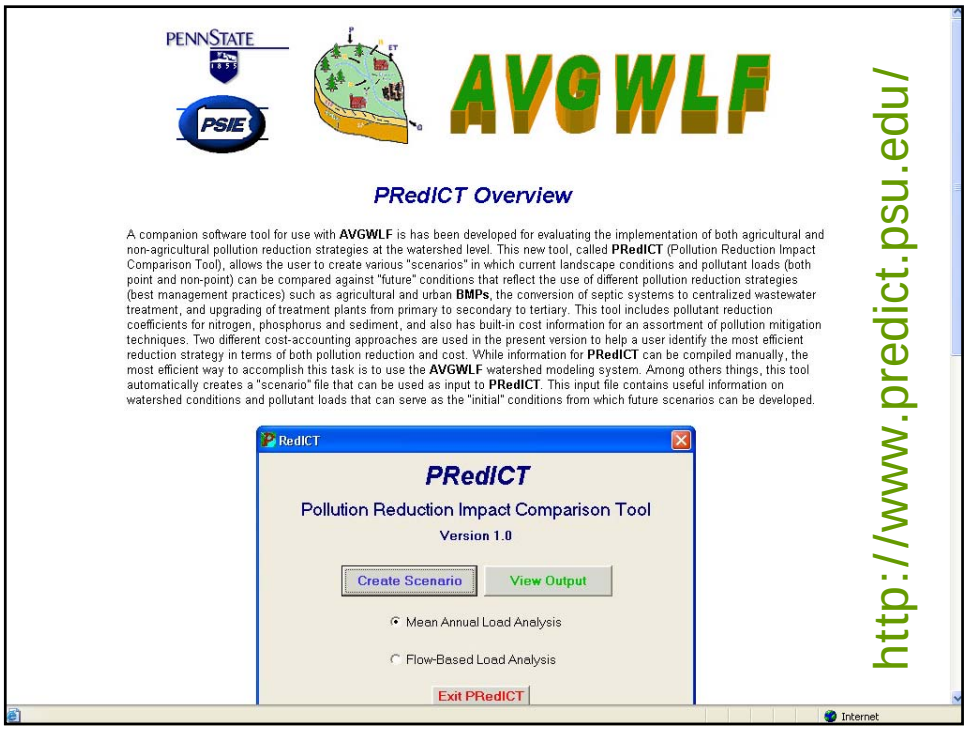
Sewer Service? ☐ Y ☐ N ○

Index of Infill, Redevelopment, and Remodeling ☐ No Evidence ☐ <5% of units ☐ 5-10% ☐ >10% ○

Record percent observed for each of the following indicators, depending on applicability and/or site complexity	Percentage	Comments/Notes	
B. YARD AND LAWN CONDITIONS			
B1. % of lot with impervious cover			
B2. % of lot with grass cover			○
B3. % of lot with landscaping (e.g., mulched bed areas)			◇
B4. % of lot with bare soil			○
**Note: B1 through B4 must total 100%*			
B5. % of lot with forest canopy			◇
B6. Evidence of permanent irrigation or "non-target" irrigation			○
B7. Proportion of *total neighborhood* turf lawns with following management status:	High: ___		○
	Med: ___		
	Low: ___		
B8. Outdoor swimming pools? ☐Y ☐N ☐ Can't Tell Estimated # ___			○
B9. Junk or trash in yards? ☐ Y ☐ N ☐ Can't Tell			○
C. DRIVEWAYS, SIDEWALKS, AND CURBS			
C1. % of driveways that are impervious ☐ N/A			

Table 5.1: Comparison of In-Stream Habitat Assessment Methods			
Characteristics	*RSAT*[1]	*RBP*[2]	*SVAP*[3]
General Description	- Evaluation of in-stream habitat - Developed for Montgomery County - Identifies channel erosion problem areas - Parameters measured at 400 ft intervals	- Evaluation of in-stream habitat - Developed by US EPA - Originally designed as a screening tool for determining if a stream is or is not supporting a designated aquatic life use	- Basic evaluation of in-stream habitat - Designed to be conducted by Soil Conservation District agents with landowner
Scoring System	6 parameters, pts vary for each	10 parameters, 20 pts each	Up to 15 parameters, 10 pts each
Land Type	High gradient streams	High and low gradient streams	High gradient streams
Watershed Type	Urbanized, nontidal	Relatively natural, nontidal	Rural or agricultural, nontidal
Experience Level	Moderate	Moderate	Low
Strengths	- User friendly - Can evaluate both channel conditions and macroinvertebrates - Tailored specifically for the Maryland Piedmont region	- User friendly - Rapid assessment - Can be integrated with bug and WQ monitoring - Great for volunteers - Can be done state-wide with little modification - Widely accepted and used protocol	- Designed to educate the landowner - Can provide landowners with ideas for improvement - Can pick and choose from parameters to customize to site conditions
Weaknesses	- Stream drainage area should be less than 100 – 150 sq. mi. - Not intended for use in Coastal Plain streams - Frequency of intervals may be time intensive	- Minor modifications may be needed to reflect local characteristics	- Meeting with each landowner could be time intensive - Would require modifications for more developed areas

1: Rapid Stream Assessment Technique (RSAT) (Galli, 1992)
2: Rapid Bioassessment Protocol (RBP) (Barbour *et al.* 1999); table only addresses the Habitat Assessment and Physiochemical Characterization portion of the RBP
3: Stream Visual Assessment Protocol (SVAP) (USDA, 1998)



RedICT

Estimated Load Reductions

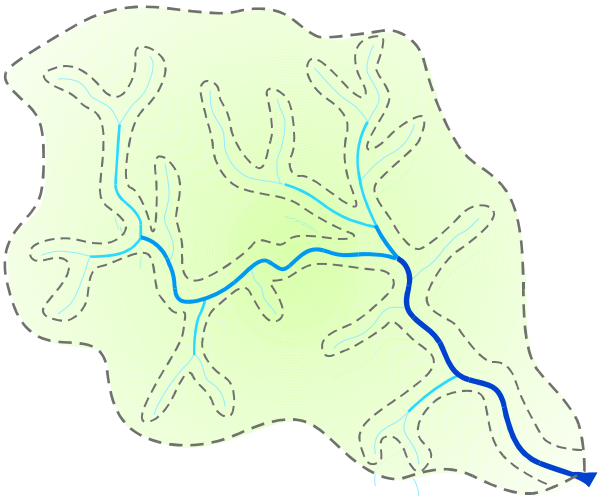
	Existing (lbs)			Future (lbs)		
UPLAND EROSION / RUNOFF	Total Sediment	Total N	Total P	Total Sediment	Total N	Total P
Row Crops	15,266,449	123,517	22,236	13,233,181	112,157	20,084
Hay/Pasture	116,623	7,798	1,209	100,063	7,112	1,107
High Intensity Urban	15,151	519	58	15,151	519	58
Low Intensity Urban	65,607	376	50	65,607	376	50
Other	549,626	4,829	505	549,626	4,829	505
STREAMBANK EROSION	11,515,109	17,273	3,984	11,064,466	16,775	3,851
GROUNDWATER / SUBSURFACE		785,968	14,708		787,214	14,708
POINT SOURCE DISCHARGES		289,669	19,314		289,669	19,314
SEPTIC SYSTEMS		20,296	101		20,296	101
TOTALS	27,527,565	1,251,245	62,165	25,027,094	1,238,947	59,778
PERCENT REDUCTIONS				9.1	1.0	3.8

SCENARIO COST $ 1,298,794.50

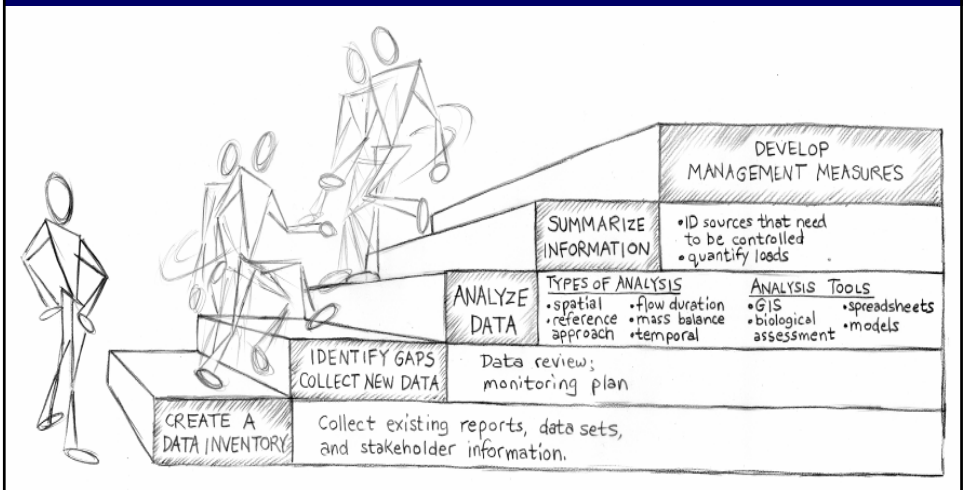
Agricultural BMP Cost 0.0 % Wastewater Upgrade Cost 0.0 % Urban BMP Cost 0.0 %

Back | Perform Optimization | Generate Report | Exit

Management Zones Based on Proximity to Water Body



Watershed analysis is on ongoing learning process – iterative & creative!



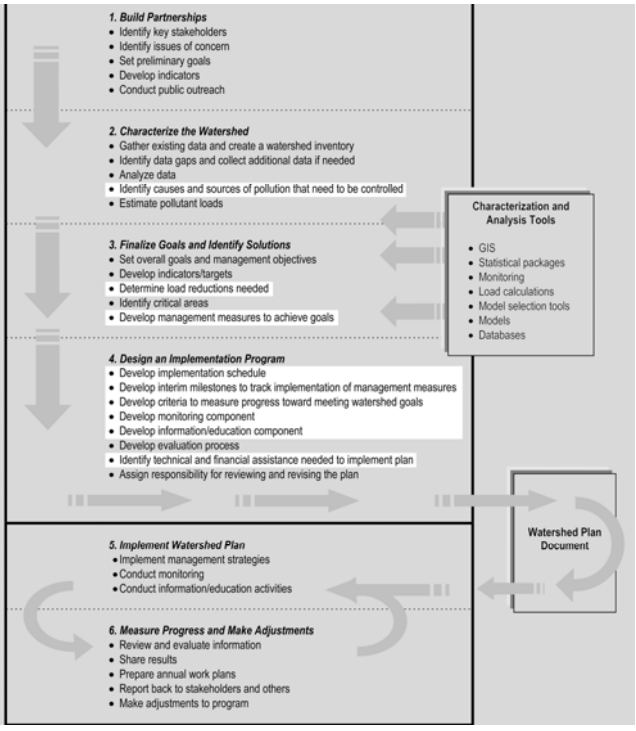
3. An estimate of the water quality-based goals expected to be achieved by implementing the measures described in element 2 above.

To the extent possible, estimates should identify specific water quality based goals, which may incorporate, for example: load reductions; water quality standards for one or more pollutants/uses; NPS total maximum daily load allocations; measurable, in stream reductions in a pollutant; or improvements in a parameter that indicates stream health (e.g., increases in fish or macroinvertebrate counts). If information is not available to make specific estimates, water quality based goals may include narrative descriptions and best professional judgment based on existing information.

Goals: What do you want to achieve?

- Identify water quality based goals for the water body
  - General goals
  - Specific load reductions
- Stressors & sources to be controlled linked to goals
- Prioritize the stressors & sources according to your goals

Assigning tasks, implementing actions, and monitoring progress



EPA's Nine Elements of Plans

- a. Identify causes & sources of pollution
- b. Estimate load reductions expected from BMPs
- c. Describe mgmt measures & targeted critical areas
- d. Estimate technical and financial assistance needed
- e. Develop an education component
- f. Develop a reasonably expeditious project schedule
- g. Describe interim, measurable milestones
- h. Identify indicators to measure progress
- i. Develop a monitoring component

Source: US EPA, 2004 319 Supplemental Guidelines

Asking the right questions . . .

- Who can help implement the BMPs or controls?
  - Agencies, businesses, non-profits, citizens, producers
- How can they be implemented?
  - What has been done in the past?
  - How well did it work?
  - Can we do it (or adapt it) here?
- When can we get started?
  - Reasonable short-term actions
  - Long-term or major actions
- How do we know if it's working?
  - And what do we do if it's not?

4. An estimate of the amounts of technical and financial assistance needed,

associated costs, and/or the sources and authorities that will be relied upon to implement the plan. As sources of funding, Tribes should consider other relevant Federal, State, local and private funds that may be available to assist in implementing the plan.

Technical & financial assistance

- Funding sources
  - Grants, contracts, donations
  - Supplemental Env. Projects
- Sources of technical assistance
  - Internal and external
  - Volunteer and other monitoring
  - Outreach and education support
  - Design/engineering assistance
- Regulatory or other authority
  - Health dept. planning/zoning
  - WHPP, SWPP, etc.
- Matching support sources
  - Be creative!

Cost data from South Branch of the Yellow Medicine River implementation plan

Table 5.1

Control Measure	YMRWD Incentive	Unit	FC removal
Feedlot Runoff Reduction	$10,000	Feedlot	90%
Stream Buffer	$200	Acre	50%
Replace Open intakes w/ Blind intakes	$500	Intake	50%
Minimum Tillage	$14	Acre	25%
Nutrient Management (incorporation)	$14	Acre	90%
ISTS Upgrades	$3,000	ISTS	90%
Conservation Reserve Program	$100	Acre	50%
Fencing	$1	Feet	100%
Rotational Grazing	$20	Acre	50%

South Branch TMDL Implementation Plan Costs

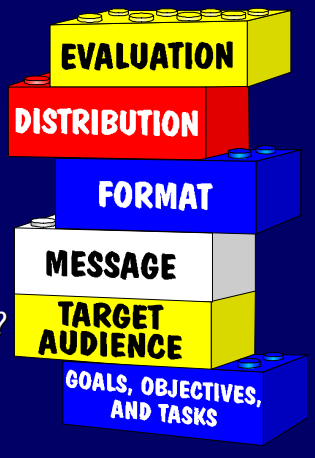
Subshed	Area Acres	Stream & Ditch ft	Stream Buffer Cost	Cultivated Acres	Minimum Tillage Cost	Nutrient Mgmt Cost	Feedlot #	Feedlot Cost	ISTS #	ISTS Cost
1	500	5383	$9,886	493	$6,907	$6,907	0	$0	8	$24,000
2	1137	12233	$22,466	1080	$15,123	$15,123	1	$10,000	1	$3,000
3	2048	22031	$40,462	1925	$26,950	$26,950	2	$20,000	10	$30,000
4	838	9016	$16,557	771	$10,793	$10,793	2	$20,000	6	$18,000
5	1032	11104	$20,394	988	$13,829	$13,829	0	$0	6	$18,000
6	2616	28142	$51,683	2563	$35,889	$35,889	1	$10,000	6	$18,000
7	575	6189	$11,367	572	$8,014	$8,014	0	$0	4	$12,000
8	1746	18786	$34,501	1692	$23,689	$23,689	2	$20,000	10	$30,000
9	994	10699	$19,649	991	$13,881	$13,881	0	$0	3	$9,000
10	2334	25108	$46,111	2278	$31,888	$31,888	0	$0	6	$18,000
11	238	2562	$4,705	237	$3,324	$3,324	0	$0	1	$3,000
12	969	10426	$19,148	963	$13,486	$13,486	0	$0	2	$6,000
13	649	6978	$12,815	298	$4,177	$4,177	0	$0	2	$6,000
14	352	3784	$6,950	271	$3,792	$3,792	0	$0	2	$6,000
15	2476	26633	$48,914	2451	$34,312	$34,312	1	$10,000	4	$12,000
16	808	5922	$10,876	806	$11,286	$11,286	1	$10,000	2	$6,000
17	2097	6862	$12,602	2082	$29,147	$29,147	3	$30,000	10	$30,000
18	494	2067	$3,796	493	$6,896	$6,896	0	$0	1	$3,000
19	2338	9466	$17,385	2331	$32,637	$32,637	3	$30,000	5	$15,000
20	516	24062	$44,191	465	$6,506	$6,506	13	$130,000	20	$60,000
21	1358	4850	$8,907	1354	$18,956	$18,956	0	$0	2	$6,000
22	1252	9793	$17,985	1250	$17,494	$17,494	1	$10,000	7	$21,000
23	896	9212	$16,918	895	$12,524	$12,524	1	$10,000	2	$6,000
24	826	8099	$14,874	806	$11,282	$11,282	1	$10,000	7	$21,000
25	685	4560	$8,375	677	$9,479	$9,479	2	$20,000	3	$9,000
26	10723	40583	$74,533	10721	$150,089	$150,089	18	$180,000	29	$87,000
27	10010	34171	$62,757	10000	$139,994	$139,994	17	$170,000	23	$69,000
28	6896	24109	$44,277	6895	$96,532	$96,532	11	$110,000	20	$60,000
29	6277	17607	$32,336	6275	$87,856	$87,856	9	$90,000	20	$60,000
30	7944	17521	$32,178	7936	$111,110	$111,110	7	$70,000	13	$39,000
Totals	**71624**	**417958**	**$767,599**	**70560**	**$987,840**	**$987,840**	**96**	**$960,000**	**235**	**$705,000**

Coordinate with other water resource and land use programs

- Section 303, Water Quality Standards, TMDLs
- Section 319, NPS Program
- Source Water Protection Plans – local water utilities
- Wetlands Protection Programs
- EQIP, CRP, BLM, USFS, USFWS
- More…

5. Information/education component

"An information/education component that will be used to enhance public understanding and encourage early and continued participation in selecting, designing, and implementing the NPS management measures that will be implemented."

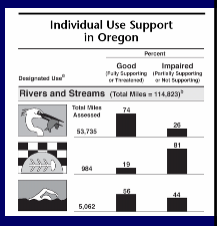


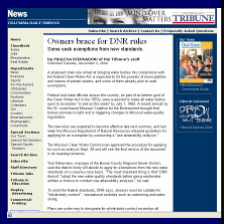
What stage of outreach or education are we at?

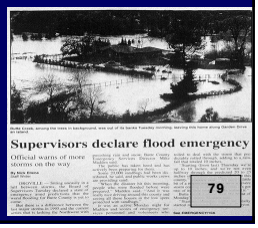
- Awareness
- Education
- Action

Developing info/ed activities

- Define overall goal and objectives
- Identify and characterize target audience
- Create message(s) for target audience(s)
- Package the messages for distribution
- Distribute messages to the audiences
- Evaluate the information/education effort







6. A schedule for implementing the NPS management measures identified in the plan that is reasonably expeditious

- Who's going to do something?
- What are they going to do?
- Where will they do it?
- When will they do it?
- How will they do it?

- *Lots of detail for the short term*
- *Less detail for long-term projects*

7. A description of interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented

- Tracking system for BMP implementation
- Usually describes implementation steps, actions taken, etc.
- Tied to project schedule
- Helpful to put in a table

8. A set of criteria that can be used to determine whether the water quality-based goals are being achieved over time and substantial progress is being made towards attaining water quality-based goals and, if not, the criteria for determining whether the watershed-based plan needs to be revised.

Types of indicators

- Environmental Indicators:
  - # of occurrences of algal blooms
  - miles of streambank restored or fenced off
  - % increase in "healthy-stream" critters
  - Increase in DO
  - # of waterbodies restored
- Administrative/programmatic indicators
  - # of BMPs installed
  - # of newspaper stories printed
  - # of people educated/trained
  - # of public meetings held
  - # of volunteers attending activities
  - # of storm drains stenciled

Example milestones

- Short-term (<1 yr)
  - Achieve 25% reduction in sediment load on 1,000 acres of ag land in the Cross Creek watershed by implementing rotational grazing practices.
- Mid-term (1-4 yrs)
  - Reduce streambank erosion and sediment loading rate by 30% by reestablishing vegetation along 3,600 feet of Cross Creek.
- Long-term (>5 yrs)
  - Restore upper reaches of 6 tributaries and create buffer easements along 15,000 ft of Cross Creek feeder streams.

Planning to git 'r done!

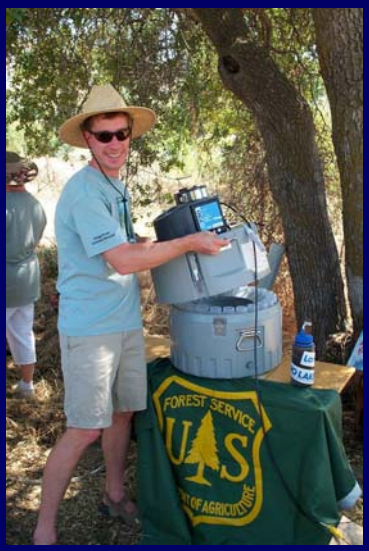
✎ Worksheet 12-1

Sample Implementation Plan Matrix

Watershed Goals
Goal 1: Restore water quality to meet designated uses for fishing
Objective 1: Reduce sedimentation by 20 percent

Tasks for G1/O1	Respon. Party	Total Costs	Funding Mechanism	Indicators	Milestones			
					Short < 1 yr	**Med < 3 yr**	**Long < 7 yr**	**Remaining**
Task 1 Seek donation of conservation easements from property owners along Baron Creek	Local land trust	$0		# acres donated	2	7	10	10
I/E Activities Task 1 Hold informational workshop with property owners Develop brochures on how to donate easements	Local land trust	$3,000	Sect. 319 funding	# workshops held # participants # requests for assistance	3 40 2	3 45 4		0
Task 2 Purchase greenway alongside Baron Creek	County park district	$2,000/ mile	County general funds	# miles purchased	2	4	7	5
I/E Activities Task 2 None								

9. A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under element 8 above.

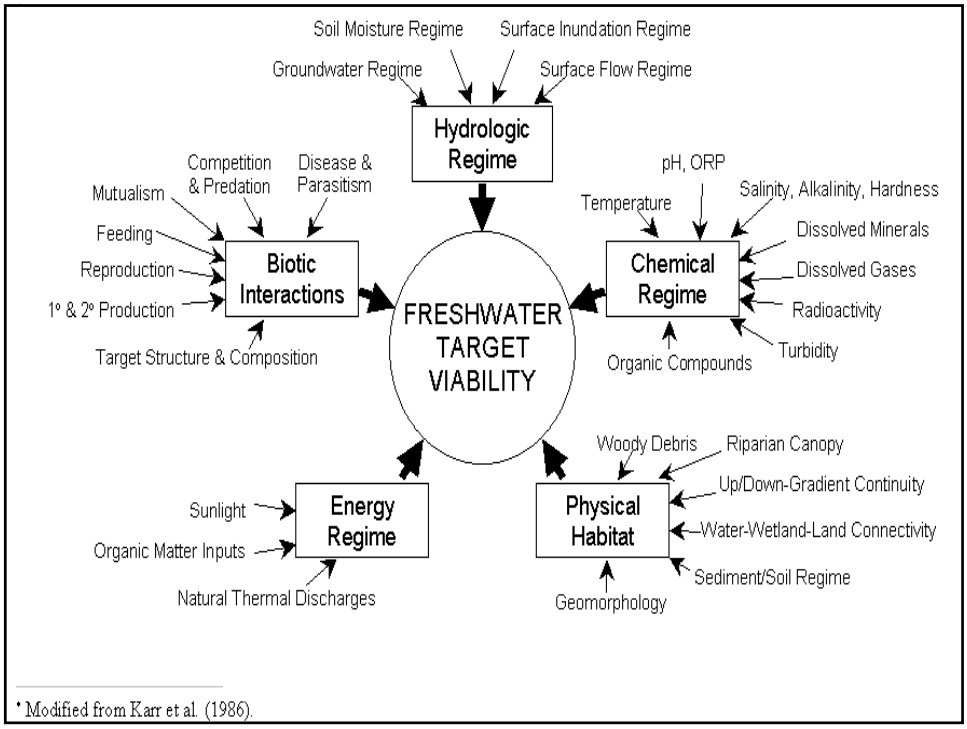


Nine monitoring parameters for tribes

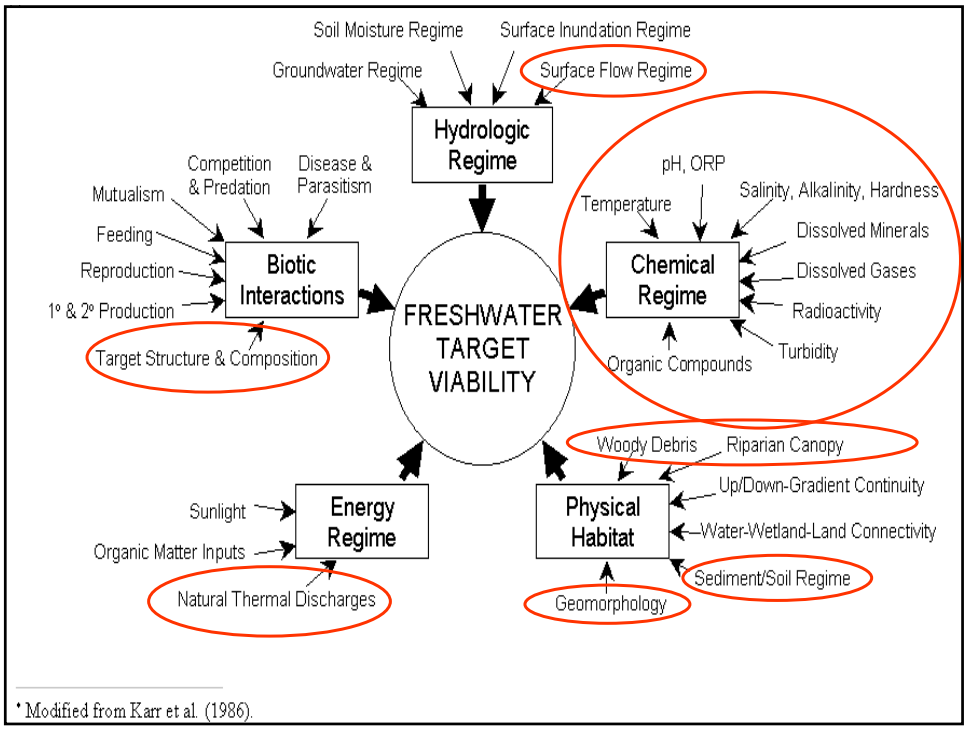
- Fundamental parameters
  - Dissolved oxygen
  - pH
  - Water temperature
  - Turbidity
- Intermediate parameters
  - Phosphorus
  - Total nitrogen
- Mature program reporting parameters
  - Macroinvertebrates
  - *E. coli* or enterococci
  - Basic habitat information

What should we monitor?

- Indicators that:
  - Characterize the watershed
  - Define and/or refine your understanding of the problem(s), such as water quality criteria violations, etc.
  - Show changes in targeted water quality or habitat conditions
  - Efficiently provide effective management information



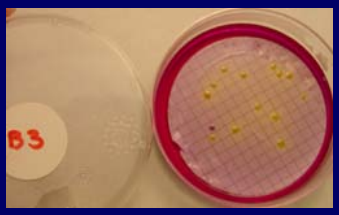
* Modified from Karr et al. (1986).

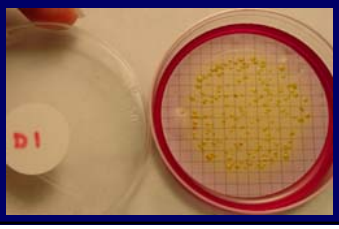


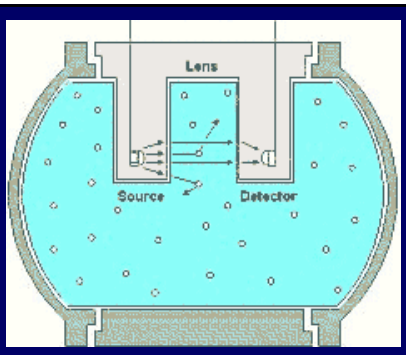
* Modified from Karr et al. (1986).

Digital dissolved oxygen probes

Most programs measure fecal coliform bacteria "colony-forming units" per 100 milliliters of raw water, or E. coli counts

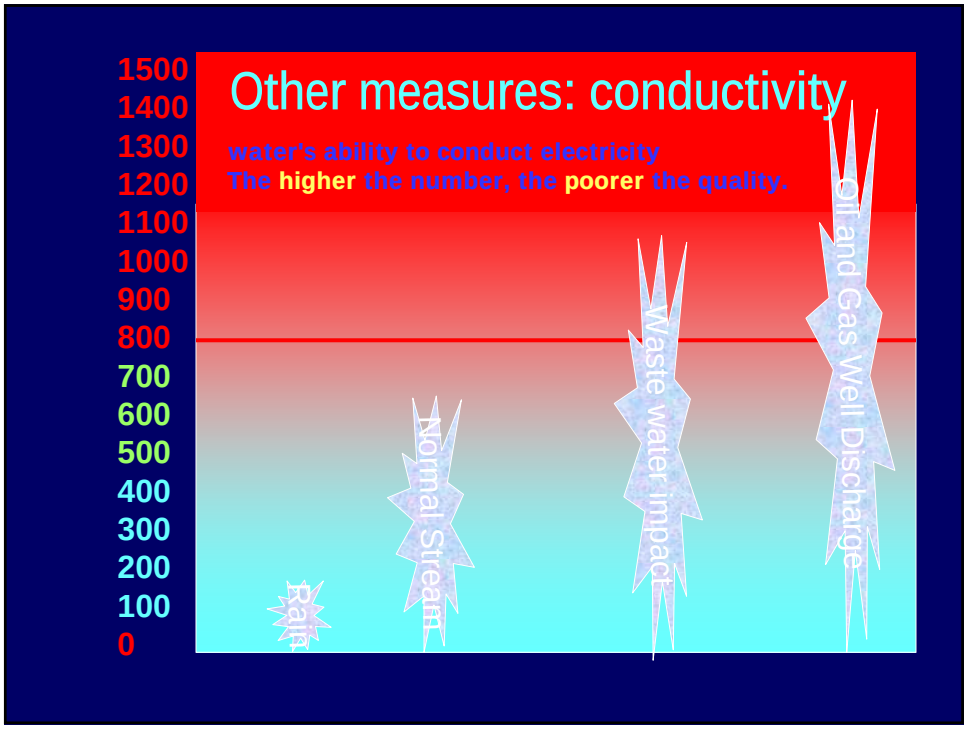






Turbidity meter, imhoff cones, and secchi disk for measuring suspended solids & water clarity

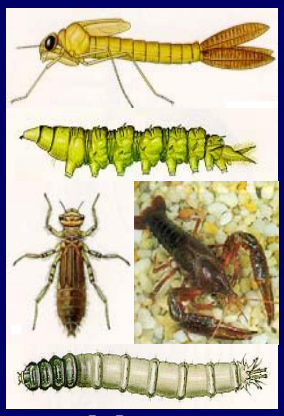
pH testers


1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
Other measures: conductivity
water's ability to conduct electricity
The higher the number, the poorer the quality.
Oil and Gas Well Discharge
Waste water impact
Normal Stream
Rain

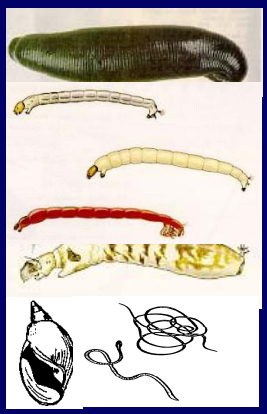

TDSTestr 3™
with ATC
0 to 1990 µS
Conductivity meter (and you get a thermometer!)

Organisms can be categorized according to their tolerance for pollution or poor habitat conditions

Good



Mid Range



Poor

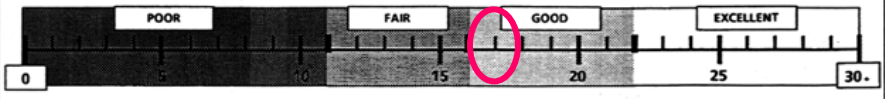
www.epa.gov/bioindicators/html/benthosclean.html

MACROINVERTEBRATE TALLY

GROUP 1 TAXA	CODE	GROUP 2 TAXA	CODE	GROUP 3 TAXA	CODE
WATER PENNY LARVAE	X	DAMSELFLY NYMPHS		BLACKFLY LARVAE	
MAYFLY NYMPHS		DRAGONFLY NYMPHS	X	AQUATIC WORMS	X
STONEFLY NYMPHS		CRANE FLY LARVAE		MIDGE LARVAE	
DOBSONFLY LARVE	X	BEETLE LARVAE		POUCH SNAILS	X
CADDISFLY LARVAE		CRAYFISH	X	LEECHES	
RIFFLE BEETLE ADULTS		SCUDS			
OTHER SNAILS	X	CLAMS	X		
		SOW BUGS / ISOPODS			
Number of taxa present	3	Number of taxa present	3	Number of taxa present	2
Times index value of (3) =	9	Times index value of (2) =	6	Times index value of (1) =	2

Cumulative Index Value	17

BIOLOGICAL QUALITY ASSESSMENT SCALE



SEND REPORT FORM TO: WATER WATCH BIOLOGICAL STREAM ASSESSMENT TEAM

Stream Bottom Structure & Critter Cover

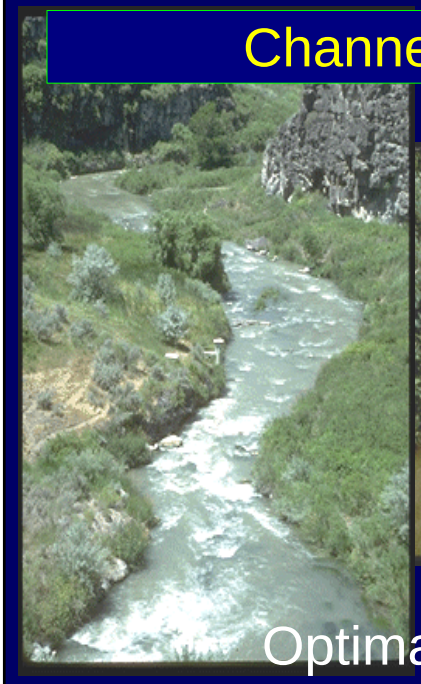
Embeddedness

Sediment Deposition

Optimal

Poor Range

Channel Flow Status



Optimal

Poor Range

Channel Alteration

Optimal

Poor Range

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME	LOCATION	
STATION #_____ RIVERMILE_____	STREAM CLASS	
LAT _____ LONG _____	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE _____ TIME _____ AM PM	REASON FOR SURVEY

	Habitat Parameter	Condition Category			
		Optimal	Suboptimal	Marginal	Poor
meters to be evaluated in sampling reach	1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
	SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
	SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Measurable indicators for assessing conditions along the bank area

Bank Stability

Bank Vegetative Protection

Optimal

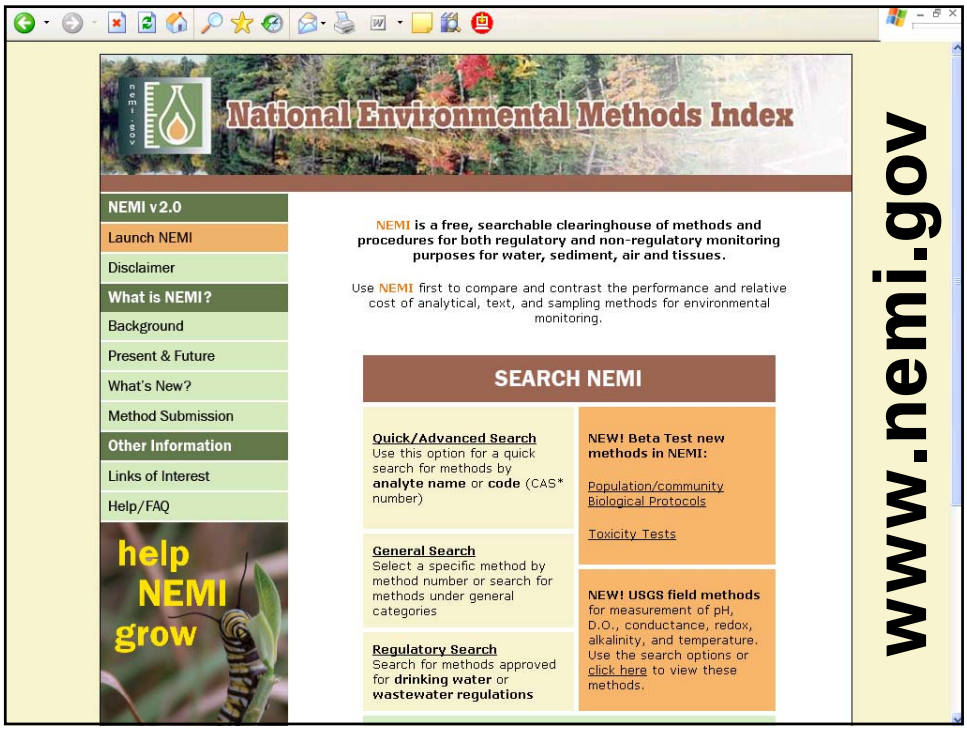
Poor Range

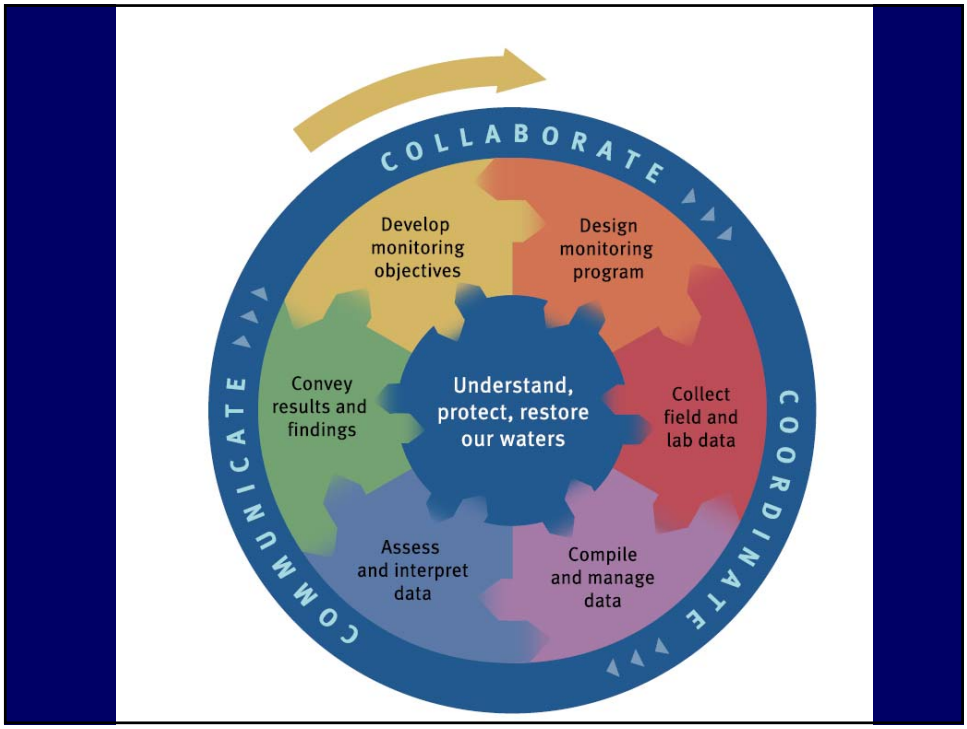
Riparian Vegetative Zone Width

Optimal

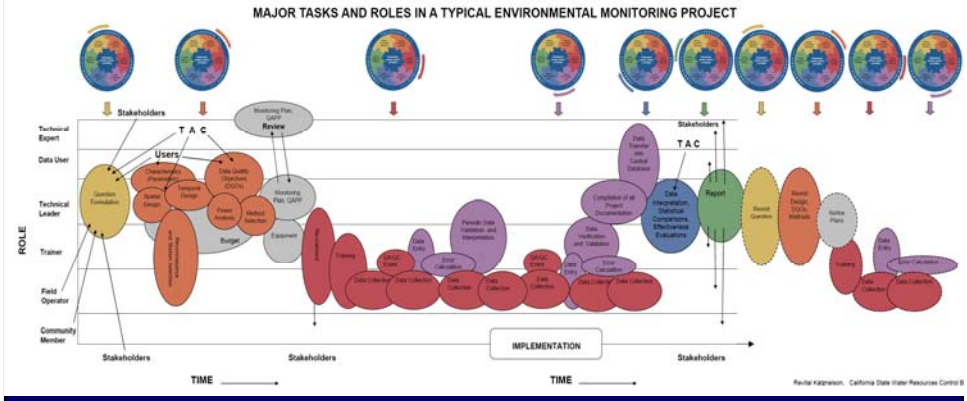
Poor Range

8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.			Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.			Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.		
SCORE ___ (LB)	Left Bank	10	9	8	7	6	5	4	3	2	1	0
SCORE ___ (RB)	Right Bank	10	9	8	7	6	5	4	3	2	1	0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.			70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.			50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.			Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.		
SCORE ___ (LB)	Left Bank	10	9	8	7	6	5	4	3	2	1	0
SCORE ___ (RB)	Right Bank	10	9	8	7	6	5	4	3	2	1	0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.			Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.			Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.			Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.		
SCORE ___ (LB)	Left Bank	10	9	8	7	6	5	4	3	2	1	0
SCORE ___ (RB)	Right Bank	10	9	8	7	6	5	4	3	2	1	0

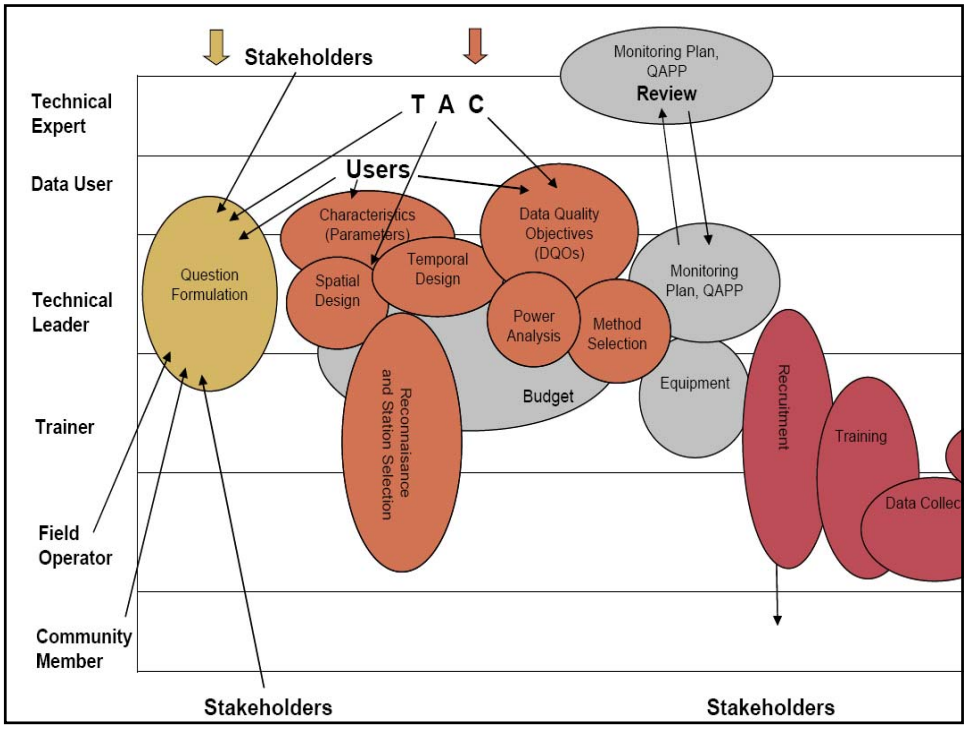


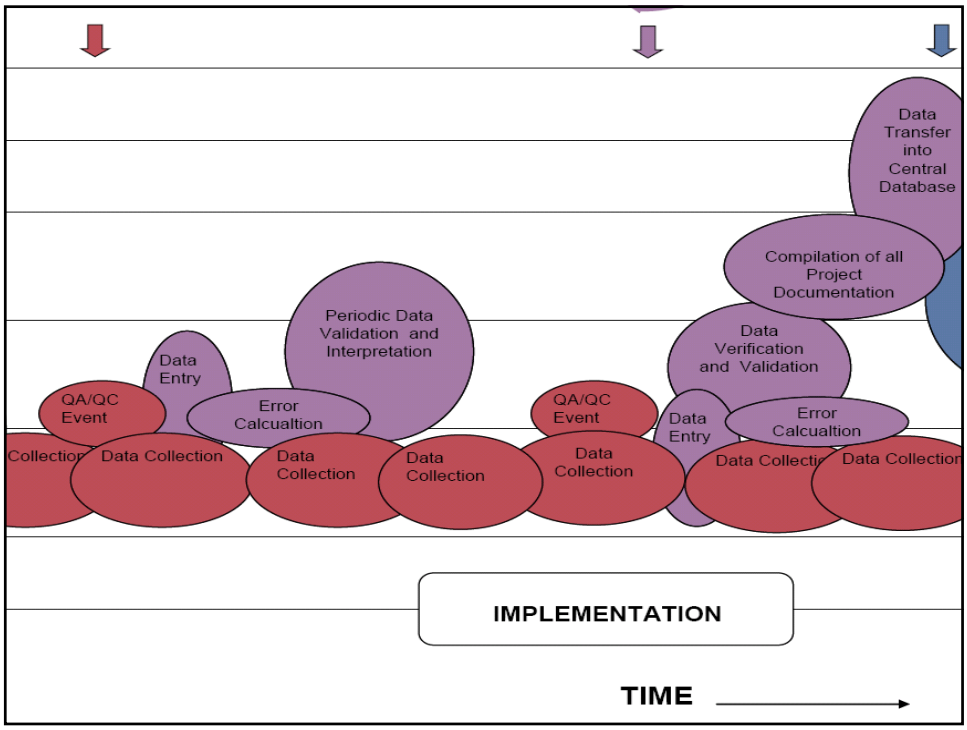


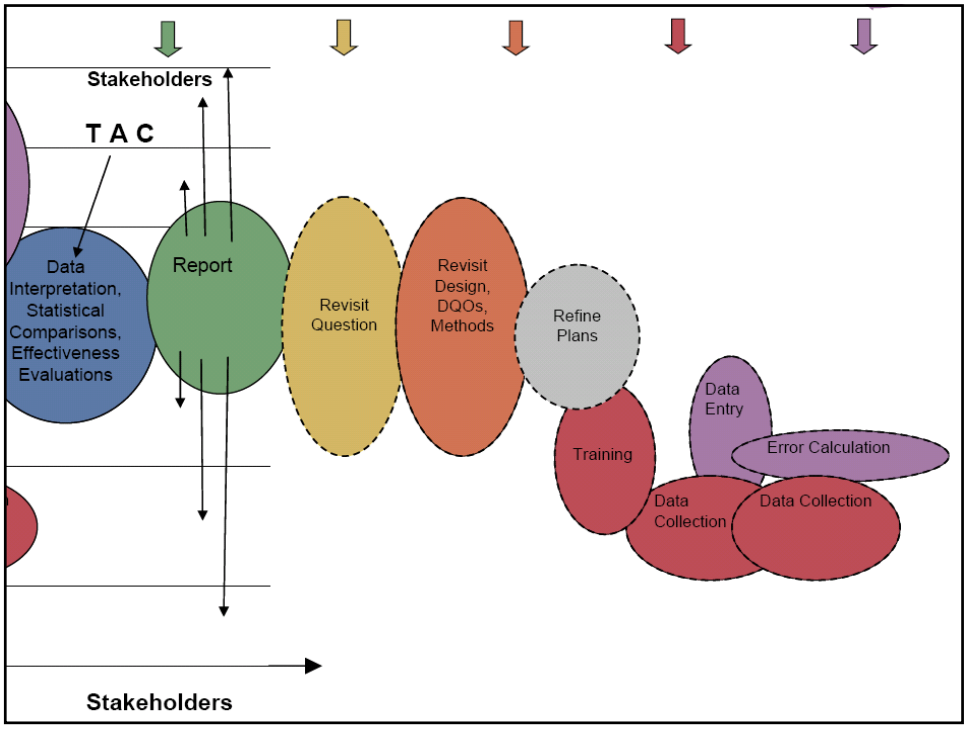
Designing a monitoring program

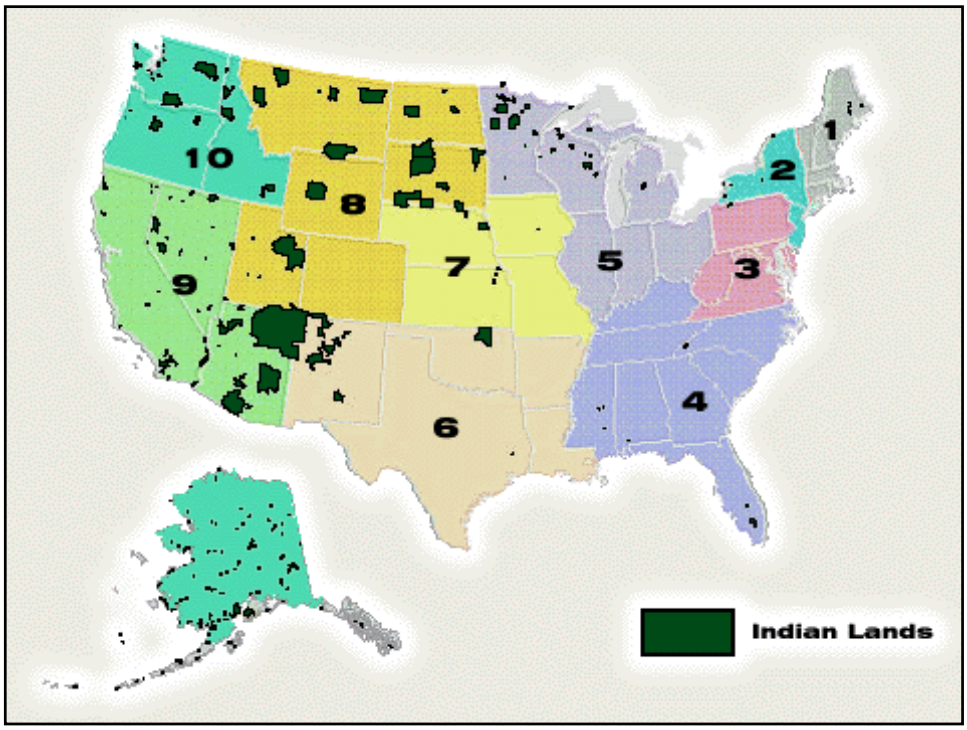


http://www.waterboards.ca.gov/index.html


Stakeholders
Monitoring Plan, QAPP Review
Technical Expert
T A C
Data User
Users
Characteristics (Parameters)
Data Quality Objectives (DQOs)
Question Formulation
Spatial Design
Temporal Design
Monitoring Plan, QAPP
Technical Leader
Power Analysis
Method Selection
Budget
Equipment
Recruitment
Training
Reconnaisance and Station Selection
Trainer
Field Operator
Community Member
Stakeholders
Stakeholders


Data Transfer into Central Database
Compilation of all Project Documentation
Periodic Data Validation and Interpretation
Data Verification and Validation
Data Entry
QA/QC Event
Error Calcualtion
QA/QC Event
Data Entry
Error Calcualtion
Data Collection
Data Collection
Data Collection
Data Collection
Data Collection
Data Collection
IMPLEMENTATION
TIME


Stakeholders
T A C
Data Interpretation, Statistical Comparisons, Effectiveness Evaluations
Report
Revisit Question
Revisit Design, DQOs, Methods
Refine Plans
Training
Data Entry
Error Calculation
Data Collection
Data Collection
Stakeholders


1
2
3
4
5
6
7
8
9
10
Indian Lands